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ARMY SCIENCE BOARD

1993 SUMMER STUDY
FINAL REPORT

on

INNOVATIVE ACQUISITION STRATEGIES FOR THE 90s

July 1994

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After reviewing the new National Military Strategy, the security environment (post cold war), and the modernization vision of jointly deploying to contingencies and maintaining land force dominance, the panel looked at three time frames from which to base its recommendations (1980s, Now, and the Future). Five recommendations were made and will be reviewed in turn, 1) technology upgrades, 2) digitization, 3) simulation, 4) acquisition system, and 5) resources.

The Army acquisition strategies for the 1990s are evolving to a future set where technology upgrades will be the option for continued land force dominance as opposed to the new starts of the 1980s. Digitization will be the key strategy to total synchronization of the battlefield by control of the battle space, the tempo, and the environment. New processes and controls such as a two step acquisition process are available from the best commercial practices of industry. They should be applied to modernization through technology upgrades to carry out the vision of land force dominance. Metrics and standards will supplant competition as the control mechanism for costs, risk, performance, and schedule. The Army needs to settle in to a sole source environment within a stable of qualified vendors. Properly controlled, this will assure a vendor base and avoid the no longer affordable cost of competition for competition's sake. The move to the future will not be business as usual. The recommendations of this study call for cultural change. The Army is off to a great start and now needs to shift gears to accelerate this new way of doing business into the mainstream of acquisition. The resourcing step is not trivial. Given reduced resources, there are no good alternative for finding funds for technology upgrades. Program cuts, retirement of obsolete equipment, and sustaining base cuts are necessary. The goal is maintaining the fighting edge of the world's finest Army.

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EXECUTIVE SUMMARY

Early in 1993, the Acting Assistant Secretary of the Army for Research, Development, and Acquisition, ASA(RDA), tasked the Chairman of the Army Science Board to conduct a Summer Study to develop innovative acquisition strategies for the 1990's. The tasking letter included the Terms of Reference (TOR) for the study which had seven specific tasks. The overall theme was to identify how to insert technology into Army systems in order to maintain battlefield dominance.

The study group collected information during the Spring of 1993 and concluded its work at the 10 day summer session in Monterey, California. The emerging results were briefed to the Army Chief of Staff in August and a second session in October to specifically review the panel's recommendations for the Army Command and Control System.

The panel followed the TOR throughout the study. Special emphasis was given to the technology upgrade task, i.e.. Horizontal Technology Integration (HTI) and Vertical Technology Insertion (VTI) and the HTI embedded task of "digitization".

After reviewing the new National Military Strategy, the new security environment (post cold war), and the modernization vision of jointly deploying to contingencies and maintaining land force dominance, the panel looked at three time frames from which to base its recommendations (1980s, Now, and the Future). Five recommendations were made and will be reviewed in turn, 1) technology upgrades, 2) digitization, 3) simulation, 4) acquisition system, and 5) resources.

RECOMMENDATION 1

TECHNOLOGY UPGRADES

- Accelerate horizontal technology integration (HTI) and vertical technology insertion (VTI).

- Publish a modernization plan showing the mix of HTI and VTI, and selected few new starts.

- Acquire HTI components through product managers, and perform HTI integration and VTI through the platform program managers.

- Appoint a General Officer to oversee HTI and VTI.

RECOMMENDATION 2

DIGITIZATION

- Build on the initial demonstrations which show the benefit of digitization:

  -- Establish priorities and control costs.

  -- Codify operational requirements.

  -- Enforce standards and technical configuration.

  -- Tie the pieces together into an integrated system.

-- Extend Intervehicular Information System (IVIS) / Improved Data Modem (IDM) into other combat systems.

-- Re-baseline Army Command and Control System (ACCS).*

* Note that it was this recommendation that the Army Chief of Staff (CSA) wanted more detail on what the Army Science Board (ASB) meant. This resulted in the second briefing in October 1993. The ACCS work is included in an addendum to the Summer Study.

RECOMMENDATION 3

SIMULATION

- Exploit Simulation, Louisiana maneuvers, and Battle Labs in evaluating the mix of technology upgrades and new starts.

- Make simulation a major factor in system acquisition and testing to significantly reduce costs and time required. Increased investment is required.

- Have the Army Research Laboratory (ARL) and the Simulation, Training, and Instrumentation Command (STRICOM) manage R&D for unique applications,

BUT!!

"Adopt a strategy of exploiting technology that is developed elsewhere and do not invest in technology development for modeling and simulation except for Army-Unique needs" (from a December, 1991 Army Science Board report on Army Simulation Strategy). We felt that was worth stating again, i.e. take advantage of the commercial simulation revolution.

RECOMMENDATION 4

ACQUISITION REFORM

- Change the programming and acquisition process to enable accelerated technology upgrades by:

-- Controlling Government Overhead.

-- Revising the Funding Mechanism.

-- Instituting a 2-Step Acquisition Process for HTI and VTI.

RECOMMENDATION 5

RESOURCES

- Increase funding for Acquisition by:

  -- Reducing acquisition process costs by 30%.

  -- Cutting fixed costs and programs.

  -- Removing selected obsolete equipment.

  -- Considering selective materiel readiness reductions.

The panel estimated that the Army needs $8 billion over 10 years to perform equipment modernization through technology upgrades. The resource allocations suggested in Recommendation 5 could generate $2 billion per year but would have to be retained in the investment account and applied to technology upgrades to be meaningful. Technology upgrades need to be accelerated so that they can be funded before outyear reductions deny this marvelous opportunity.

The Army acquisition strategies for the 1990's are evolving to a future set where technology upgrades will be the option for continued land force dominance as opposed to the new starts of the 1980s. Digitization will be the key strategy to total synchronization of the battlefield by control of the battle space, the tempo, and the environment. New processes and controls such as a two step acquisition process are available from the best commercial practices of industry. They should be applied to modernization through technology upgrades to carry out the vision of land force dominance. Metrics and standards will supplant competition as the control mechanism for costs, risk, performance, and schedule. The Army needs to settle in to a sole source environment within a stable of qualified vendors. Properly controlled, this will assure a vendor base and avoid the no longer affordable cost of competition for competition's sake. The move to the future will not be business as usual. The recommendations of this study call for cultural change. The Army is off to a great start and now needs to shift gears to accelerate this new way of doing business into the mainstream of acquisition. The resourcing step is not trivial. Given reduced resources, there are no good alternatives for finding funds for technology upgrades. Program cuts, retirement of obsolete equipment, and sustaining base cuts are necessary. The goal is maintaining the fighting edge of the world's finest Army.

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The study members were selected based on previous performance, knowledge of the subject, and expertise in the areas cited in the Terms of Reference (TOR). Teamwork was the primary operating mode, and vigorous debate was always in evidence. All recommendations represent a consensus of the study members.

TERMS OF REFERENCE

- IDENTIFY HIGHEST PAYOFF BATTLEFIELD OPERATIONAL CAPABILITIES FOR HORIZONTAL TECHNOLOGY INTEGRATION (HTI) PURSUIT.
- IDENTIFY MANAGEMENT SCHEME FOR HTI.
- IDENTIFY ARMY SYSTEMS THAT YIELD IMPROVED CAPABILITIES THROUGH HTI AND THOSE THAT DON'T.
- SUGGEST BEST UTILIZATION OF BATTLE LABS AND DISTRIBUTED INTERACTIVE SIMULATION (DIS) TO EVALUATE HTI.
- SUGGEST METHODS TO MANAGE RISK, ACCELERATE ACQUISITION PROCESS FOR SPECIFIC CANDIDATES. MAKE RECOMMENDATIONS ON HOW TO BETTER ACQUIRE INFORMATION TECHNOLOGY.
- IDENTIFY TECHNICAL, ORGANIZATIONAL, REGULATORY, STATUTORY LIMITATIONS AND RECOMMEND CHANGES THAT ENABLE HTI, ACCELERATE RETIREMENT OF OBSOLETE SYSTEMS AND FIELDING OF NEW SYSTEMS AND EXPLOIT DIS.
- ESTIMATE APPROXIMATE COST AND TIMING OF HTI.

The panel followed the TOR throughout the study. Special emphasis was given to the technical upgrade task, i.e., Horizontal Technology Integration (HTI) and Vertical Technology Insertion (VTI) and the HTI embedded task "digitization."

We screened our recommendations for limitations and found few, if any. This was not the main effort. The focus was on the Army and acquisition and not reform as popularly defined by the expression "Acquisition Reform." The panel tracked the Defense Science Board study on "Acquisition Reform." In sum, our effort became a modernization study on how to resource and implement technology upgrades.

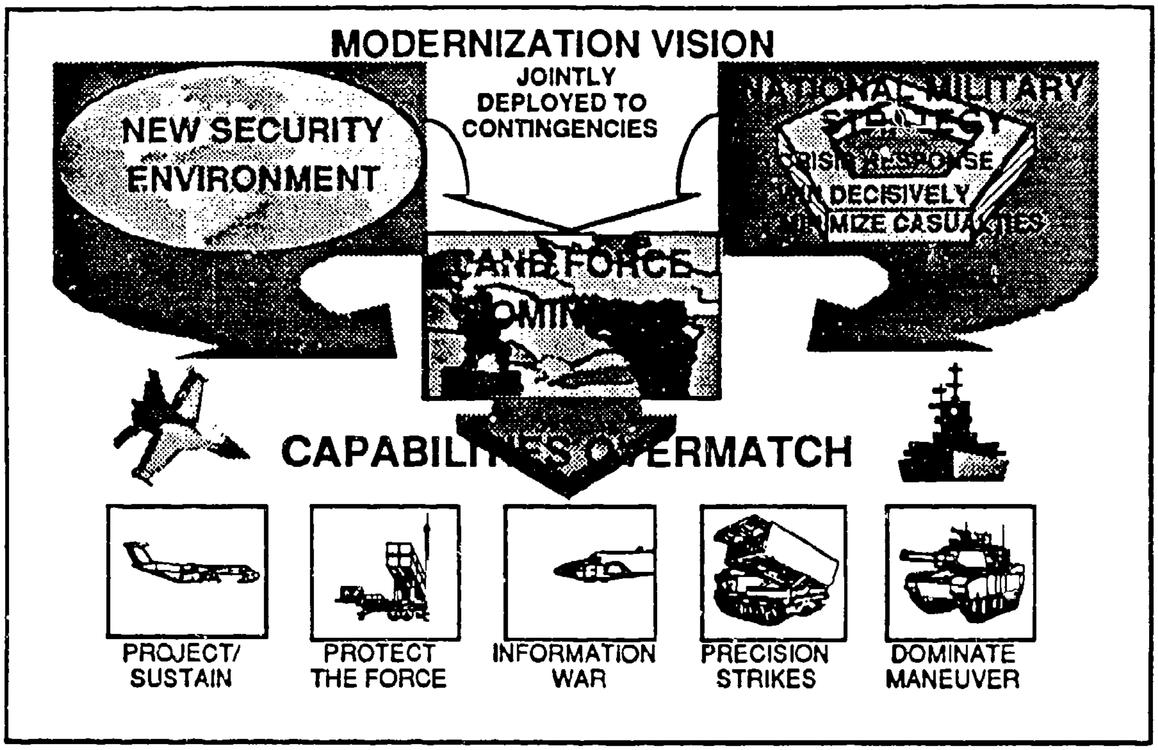
INTRODUCTION

80s	NOW	FUTURE
ENOUGH RESOURCES FOR NEW STARTS	INADEQUATE ACQUISITION FUNDING TO MAINTAIN NEW START APPROACH	TECHNOLOGY UPGRADES THE OPTION FOR CONTINUED LAND FORCE DOMINANCE. REQUIRES INCREASED INVESTMENT.
5000 SERIES, RISK AVERSE, GOV'T BURDEN	CONTINUED REFORM AND REVISION	2 STEP DEVELOPMENT TO CONTROL RISK EARLY
ANALOG	ANALOG-DIGITAL	DIGITAL
SEQUENTIAL DEVELOPMENT CYCLE, EXHAUSTIVE TEST ENVIRONMENT	PROOF OF CONCEPT THRU SIMULATION AND RAPID PROTOTYPING	REDUCED COSTS AND CYCLE TIME THRU WIDE-SPREAD USE OF SIMULATION AND RAPID PROTOTYPING
COMPETITION, SIGNIFICANT OVERHEAD	MOVING TO SOLE SOURCE, INDUSTRY REDUCTIONS, GOV'T?	SOLE SOURCE, STABLE OF QUALIFIED VENDORS, BEST COMMERCIAL PRACTICE

RECOMMENDATIONS

- TECHNOLOGY UPGRADES
- DIGITIZATION
- SIMULATION
- ACQUISITION SYSTEM
- RESOURCES

The Army acquisition strategies for the 1990's are evolving to a future set where technology upgrades will be the option for continued land force dominance, as opposed to the new starts of the 1980s. Digitization will be the key strategy to total synchronization of the battlefield by control of the battle space, the tempo, and the environment. New processes and controls, such as a two-step acquisition process, are available from the best commercial practices of industry. They should be applied to modernization through technology upgrades to carry out the vision of land force dominance. Metrics and standards will supplant competition as the control mechanism for costs, risk, performance, and schedule. The Army needs to settle in to a sole source environment with a stable of qualified vendors. Properly controlled, this will assure a vendor base and avoid the no longer affordable costs of competition for competition's sake. The move to the future will not be business as usual. The recommendations of this study call for cultural change. The Army is off to a great start and now needs to shift gears to accelerate this new way of doing business into the mainstream of acquisition. The resourcing step is not trivial and will require a lot of gut wrenching decisions and follow-up. Given reduced resources, there are no good alternatives for reapplying funds to technology upgrades. Program cuts, retirement of obsolete equipment, and sustaining base cuts are necessary. The goal is maintaining the fighting edge of the world's finest Army.



The demise of the Soviet Union has had a significant impact on US Military forces, particularly the Army. It will not be a smaller "Cold War Army," but one that is a contingency-oriented, power projection force that is primarily Continental United States (CONUS) based. Preparing the Army for unpredictable missions in a volatile unstable world is, in many ways, a much greater challenge than designing an Army to counter the Cold War threat. Predicting future requirements is always difficult, but it is even more so today. The Army must be prepared to face a myriad of diverse threats throughout the world which may erupt on short notice. If called upon to fight, it must be capable of quick, decisive victory with minimum casualties. Above all, it must possess the capability for *TOTAL LAND FORCE DOMINANCE*, whenever and wherever it is called upon to deploy in the National interest. As in all wars, it will be the soldier whose determination and bravery will ultimately win on the battlefield. It is the responsibility of the country to assure that American soldiers have the high technology weaponry to rapidly win on that battlefield, while avoiding a determined enemy's desire to kill them first. As research and development, and procurement funds are reduced, it becomes extremely important to assure that every asset is spent to provide the maximum effectiveness on the battlefield. Realizing the necessity for gaining the maximum capability from available resources, the Army has identified five modernization objectives that must be properly balanced to assure battlefield success. These objectives provide insights into the key operational capabilities that the Army must achieve as it moves into the 21st Century.

- Project and Sustain the Force. The key to projecting a CONUS-based Army is improved airlift and sealift to move forces rapidly to trouble spots throughout the world. The major responsibility for improvement in these areas rests with the Air Force and Navy. The Army however, must make a determined effort to reduce soldier load, lighten equipment without reducing its protection and lethality, and downsize forces. The latter becomes particularly important because it is the "tail" not the "tooth" that can become the "Achilles' heel" of a contingency force. Support and sustained forces must be reduced by improved automation, improved supply procedures to

reduce required pipeline, and a reduction in support requirements. Support requirements can be reduced substantially by more reliable equipment, reduced fuel consumption, and more accurate and lethal weapons systems which reduce ammunition requirements. Improved shelters, feeding systems, and other soldier support systems must not be overlooked. Their effect on combat efficiency can be the difference between defeat and victory and greatly reduce the number of soldiers required in a contingency area.

- Protect the Force. Since World War II protection of the force has frequently not been given the emphasis required because US ground forces have generally operated in an environment in which an air-delivered munitions threat was absent. This was true in spite of the massive capabilities of our Cold War adversaries. Desert Storm experience has had a sobering effect on US Forces. Over twenty nations now have tactical ballistic missiles which put our forces at risk. Though they may only have a minor effect on the operation of our maneuver forces, they can produce significant damage to airfields, ports, command and control modes, and population centers. The Army must have sensors to detect these missiles and an integrated air defense system, as well as counterfire means to destroy launchers when detected. While the Iraqi SCUDs received the most attention during Desert Storm, there are numerous other systems available to all potential adversaries which must not be ignored. These include cruise missiles, unmanned aerial vehicles, long-range artillery, and attack helicopters. Lethal munitions range from nuclear and high-explosive to chemical and biological. To protect the force from this extensive threat requires an integrated suite of weapons. The lessons of Desert Storm again raised the age-old problem of fratricide between friendly forces. The range and lethality of all types of current weapons make combat identification an absolute necessity for ground-to-ground and air-to-ground systems, as well as the more traditional ground-to-air and indirect fire problems. In totality, protecting the force can be the most difficult of the five modernization objectives to achieve. Certainly the cost of an air defense umbrella alone can be prohibitive if not approached in a rational, integrated manner.

- Win the Battlefield Information War. The Army has always sought better means of collecting enemy information to outwit, out-maneuver, and kill before being killed. Rarely has the power of information been as well-recognized as today. This is largely because of the unbelievable capability that has become available in just the last several years. It is possible to see the enemy with a wide range of sensors such as the Joint Surveillance Target Attack Radar System (JSTARS), unmanned aerial vehicles (UAVs), the Tactical Exploitation of National Capabilities (TENCAP), and other means that would astound Vietnam-era leaders. Coupled with modern communication means and data fusion capability, tomorrow's commander will literally have the capability to control the flow of information, both friendly and enemy, on the battlefield if the many capabilities available are properly integrated into a total system. That is the challenge! The battlefield of the future will truly be digitized from the squad to the corps. The power this can provide the commander, if properly utilized in conjunction with all other systems on the battlefield, is awesome.

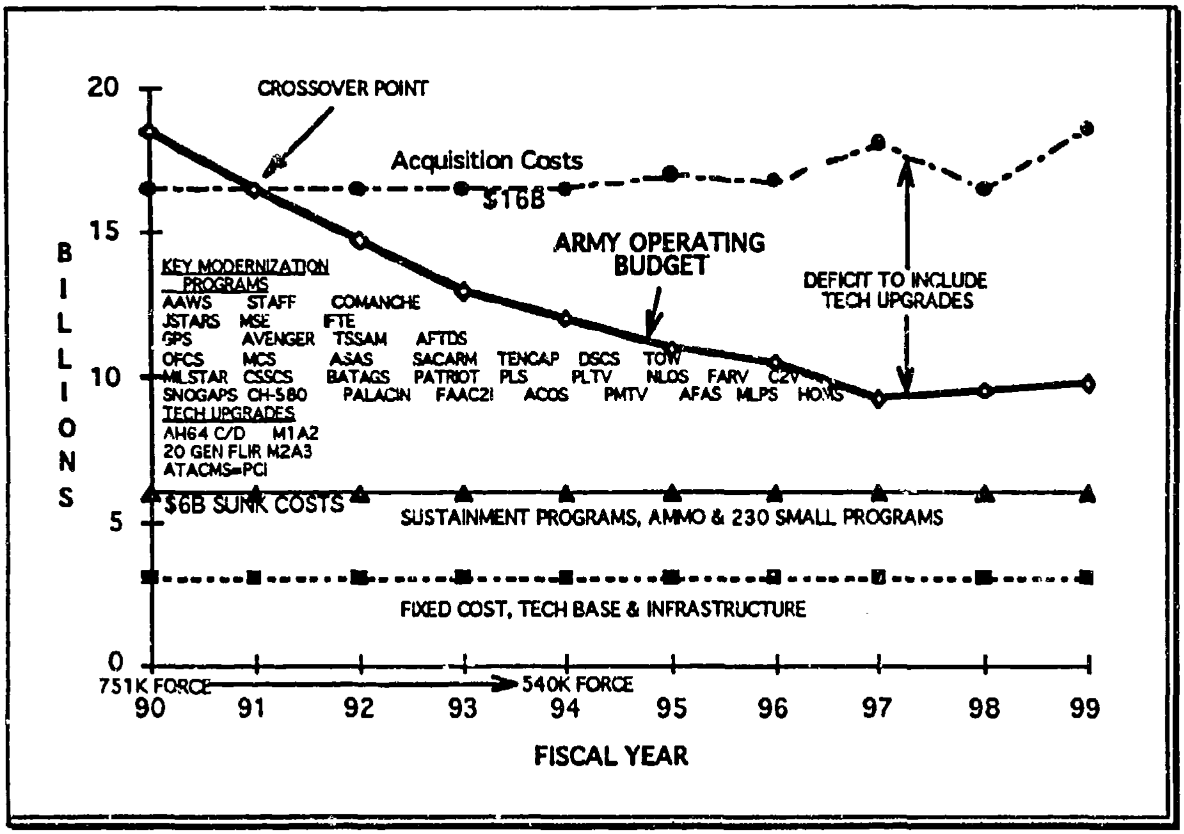
- Conduct Precision Strikes. The ultimate goal of any Army is to destroy the enemy at long range before he can destroy you. Unfortunately the attainment of that goal has been elusive because of a lack of capability to pinpoint enemy forces, followed by a lack of capability to rapidly deliver accurate and lethal fire before he moves. Today the goal of pinpointing is becoming a reality with the utilization of sensors described earlier. The challenge now is to couple these sensors with the shooters on a timeline that will permit enemy destruction before he can move. Modern long-range weapons, utilizing smart sub-munitions and employed in conjunction with fast data fusion and

communication, can make this goal a reality for many targets. There will still be some targets where this is not possible because of missile fly-out time. The challenge will be to integrate these systems now being developed under the purview of three Army branches into a truly integrated system.

- Dominate the Maneuver Battle. Ultimately, success on the battlefield of the future will come down to destroying the enemy in quick, decisive victory. That is the requirement of Land Force Dominance and the reason for the four modernization goals discussed previously. The soldiers of the future must have highly mobile systems with increased lethality. These systems range from hand-held systems, such as the Javelin, to the Comanche helicopter. The tank is not a relic of the past and must be continually improved to give it greater lethality and protection with less weight. Indirect fire means must be closely coupled with ground maneuver elements so that there is never a lack of rapid, close supporting fires. There is an urgent need for improved mobility and counter-mobility systems. Finally, the maneuver commander needs the capability of the digitized battlefield to integrate his forces into a lethal survivable force.

The Army knows what it needs to dominate the battlefield of the future. It has the doctrine, is improving its training capabilities to provide the best-trained Army in the world, and has the proper modernization goals for the future. The real challenge, however, is how to meet all these goals in a time of reduced budgets. That problem is addressed in this study.

RDA RESOURCES



The Army's problem is resources. Modernization and innovative acquisition strategies are possible only if adequately resourced. The panel believes that sustainment programs, ammunition, and the 230 small programs need to be scrubbed to generate dollars to be reapplied to technology upgrades. Fixed costs, technology base, and infrastructure need to be cut by approximately one third. Some key modernization programs will inevitably have to be terminated. The main reason for these realignments is to generate additional funding to be applied to modernizing the Army's fighting systems through the new strategy of technology upgrades (TUs) and the imaginative support processes that can carry out this vision. Technology upgrades need to be accelerated so that they can be funded before outyear reduction denies this marvelous opportunity.

TECHNOLOGY UPGRADE

HORIZONTAL TECHNOLOGY INTEGRATION (HTI)

is the application of common enabling technologies across multiple systems to improve the warfighting capability of the force.

VERTICAL TECHNOLOGY INSERTION (VTI)

is the application of enabling technology *within* a system to upgrade operational capability or reduce cost which permits improvement in warfighting capability.

The definitions for HTI and VTI were arrived at through discussion with Army officials from the staffs involved with HTI. They are offered to ensure clarity and to track our recommendations.

RECOMMENDATION 1

- TECHNOLOGY UPGRADES
- ACCELERATE HORIZONTAL TECHNOLOGY INTEGRATION (HTI) AND VERTICAL TECHNOLOGY INSERTION (VTI)
- PUBLISH A MODERNIZATION PLAN SHOWING THE MIX OF HTI AND VTI, AND SELECTED NEW STARTS
- ACQUIRE HTI COMPONENTS THROUGH PRODUCT MANAGERS, AND PERFORM HTI INTEGRATION AND VTI THROUGH THE PLATFORM MANAGERS
- APPOINT A GENERAL OFFICER TO OVERSEE HTI AND VTI
  - Provide technical support

Technology upgrades, both horizontal and vertical, are the recommended acquisition strategy for the future. The Army has started this process and can accelerate this effort into the mainstream of day-to-day business. As the next chart on opportunities and cost shows, this is a complex issue and therefore deserves a new management activity to focus on systems upgrades, both from an operational and an acquisition standpoint. The policy of acquiring HTI components through product managers and performing HTI and VTI through the platform program managers should be implemented.

The new Director of HTI and VTI will require technical support to ensure adherence to standards and interface controls and to ensure that the array of upgrades are harmonized and provide increased battlefield effectiveness. Giving the new Director program authority will help ensure control.

INNOVATIVE ACQUISITION STRATEGIES

7 HORIZONTAL TECHNOLOGY INTEGRATIONS ⟹ 24 SYSTEMS

- COMBAT ID
- POS/NAV
- 2nd GEN FLIR
- TACTICAL C2 DIGITIZATION
- SURVIVABILITY SUITE
- BRILLIANT MUNITIONS
- COTS
  - Comm Stds, Bus Re Engr

ABRAMS	M88	120MM MORTAR
HMMWV SCOUTS	BRADLEYS	CEV
BRIDGERS	MSALE	C2 VEH
AGS	BFIST	FOX NBC VEH
M109	B-STINGERS	KIOWA HELOS
MLRS	LONGBOW	AVENGER
UH 60 HELO	AFAS	FAARV
SINCGARS	MSE	CDS

13 SYSTEMS ⟸ 25 VERTICAL TECHNOLOGY INSERTIONS

- FIREFINDER
- ATACMS
- STINGER
- PATRIOT PAC 2
- SINCGARS
- LOGISTIC VEHICLES
- MSE
- FOX NBC VEH
- GUARDRAIL
- BAT
- UAV-SR
- BFV
- TANK COMPONENTS

COSTS ABOUT $8 BILLION OVER 10 YEARS*

UPGRADE COST LARGE, BUT FRACTION OF NEW SYSTEMS

* Does not include the cost of those HTI items for new production systems (e.g., AFAS, FAARV).

This chart is the centerpiece of the study! The work to generate systems and upgrade opportunities are shown in Appendix B. These seven HTIs to 24 systems and 25 VTIs to 13 systems are the opportunities for upgrade. When set up in matrices, each cell needs to be inspected before agreement on a specific upgrade to a system. However, outlining this population is useful to show the enormity and complexity of the task as well as the opportunity to provide rough-order-of-magnitude costing. The seven HTI opportunities were chosen based on rationale outlined Appendix B. These are not the only opportunities but the panel felt that they are the most important. This chart represents a statement of work for the new director. Approximately $8 billion over ten years is a significantly lower price tag to allow the Army to preserve cutting edge systems than would be the case if all new starts were even thinkable. The rationale for these upgrades are covered in depth in Appendix B.

RECOMMENDATION 2

DIGITIZATION

BUILD ON THE INITIAL DEMONSTRATIONS WHICH SHOW THE BENEFIT OF DIGITIZATION:

- Establish priorities and control costs
- Codify operational requirements
- Enforce standards and technical configuration
- Tie the pieces together into an integrated system
- Extend IVIS/IDM into other combat systems
- Rebaseline Army Command and Control System (ACCS)

Recent "Digitization" exercises have clearly demonstrated the potential of a digitized battlefield. The combat advantage of these early systems is impressive. The potential to be realized by digitizing the tactical weapon systems and the supporting command and control elements, i.e., Command and Control Vehicle (C2V) and Common Ground Station (CGS), is far greater. However, the experience to date with the independent development of the Intervehicular Information System (IVIS) and the Improved Data Modem (IDM) illustrates the need to clarify the requirements for the digitized battlefield and to put someone in charge of implementing this process.

For the purpose of this study the panel has defined digitization as the application of digital technology to provide real-time combat information throughout the tactical combat forces. The ability of all combat systems to maintain current situational awareness, to coordinate operations, reconnaissance, maneuver, and fires across the combat arms systems can provide a dramatic impact in their combat capability, in both the offense and the defense. Further, the availability of the current situation on all weapon platforms will minimize the likelihood of fratricide. However, this performance will not be achieved unless a clear vision of the need is articulated and unless the solution conforms to a consistent set of open standards.

Digitization involves the following:

(1) Collection of digital data from sensors, man–machine interface devices, fire control systems, and other vehicle systems (i.e., engine management). In cases where an older combat system is digitized, it may be necessary to include analog to digital conversion devices to provide the digital interface to existing subsystems. The interface/collection process is usually achieved over a Local Area Network (1553 Bus).

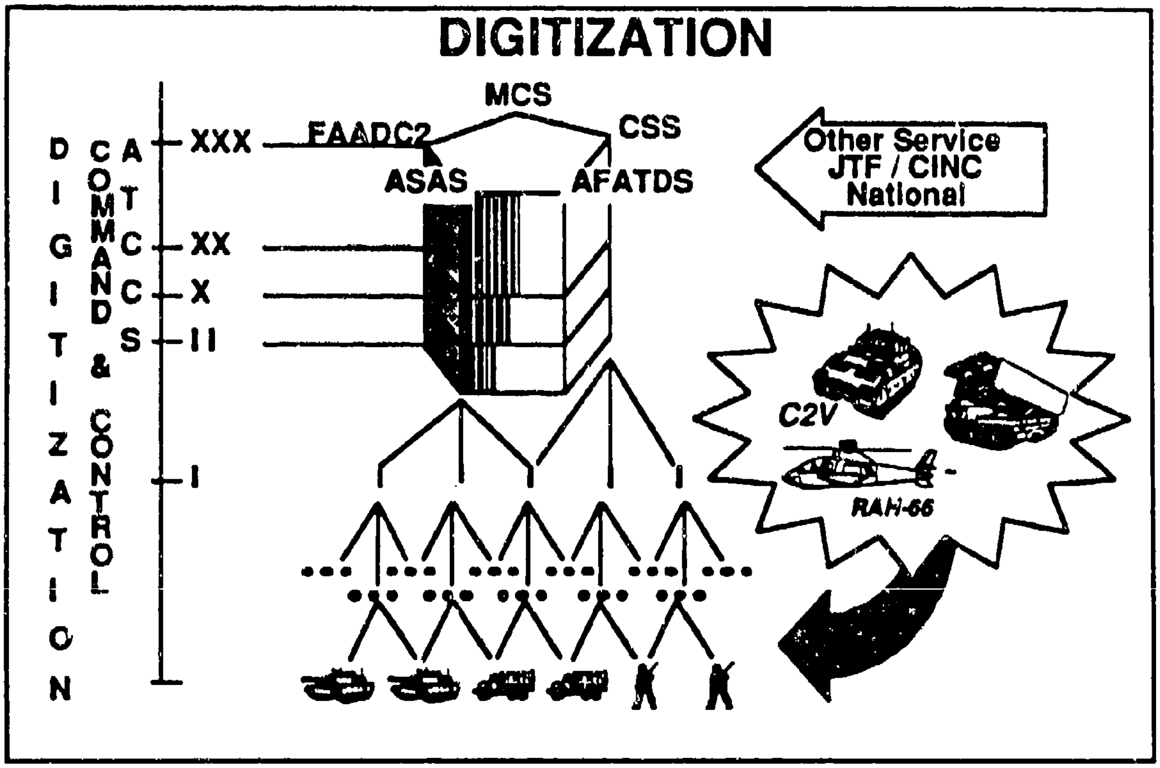
(2) Processing of collected data by an on-board computer. Data are manipulated and formatted for on-board display, input to fire control systems, and for reporting

(usually via radio) to other users. On-board storage devices compact disk, read-only memory (CD ROM) will provide map backgrounds, digital terrain, etc.

(3) The distribution of digital data through Combat Net Radio, Enhanced Position Locating and Reporting System (EPLRS) and/or wire to other digitized weapons or to the Army Tactical Command and Control System (ATCCS). This distribution function is usually performed in a broadcast mode to provide current data to multiple recipients—the platoon leader can simultaneously update the company commander and his subordinates within the platoon.

(4) The display of data for action/decision. The display device may present: alpha-numeric data — a fire message within IDM / Advanced Field Artillery Tactical Data System (AFTADS); a graphic situation display to provide current situational awareness; or a combination of alpha-numeric and graphical data. The display device will usually support the development of a message — a call for fire, for example.

The digitized battlefield will include all the combat weapon systems M1, M2, M3, Avenger, PALADIN, FIST, MLRS, AH-64, OH-58, Comanche, and light force elements, as well as the CGS, GBCS, C2V, and the ABCCs. These digitized vehicles must be capable of interchanging data with the Battlefield Functional Areas (BFAs) within ATCCS. In the larger view of digitization, it is critical that the interface standards for IVIS and ATCCS be compatible to support Command and Control (C2) across the brigade boundary. This global view of digitization is illustrated below.



As identified earlier, the panel recommends the appointment of a Director of HTI and VTI with an integrated development team to minimize the delay and the cost of implementing a digitized force. In the current constrained environment, it will be necessary to establish priorities within the

digitization world and to rank these programs within overall Army priorities. A major objective of this office must be cost control of all elements of this complex program.

Experimentation to date has demonstrated the capability of IVIS within the tank force and a limited interchange between tanks and helicopters. To avoid further false starts, it is important that requirements be derived for each of the combat systems from the perspective of the combined arms team. These requirements must identify data needs and timeliness requirements which will size the digital communications necessary to support the real time battle. These codified requirements must be harmonized with the ATCCS to insure that each BFA element can interoperate with the subordinate weapon systems. An illustration of the type of potential application analysis of digitization across the tactical forces which needs to be completed is shown in Table 1.

POTENTIAL DIGITIZATION

PLATFORM INFO	INF	M1	M2/3	ADA	ARTY	AVN	ENGR	CGS	C2V
RED SIT									
BLUE SIT AND STATUS									
AIR TRACK DATA									
"BATTLE DAMAGE ASSESSMENT"									
FIRE REQUESTS									
WEATHER AND NBC									
MAPS TERRAIN DTED/LOS									

Table 1: Potential Digitization

An important derivative of this requirements process must be the establishment of standard system interfaces, protocols, and data elements. The technical configuration will be driven by both the operational requirements and these system-wide technical specifications. In light of the joint emphasis by the Department of Defense (DoD) and the Joint Chiefs of Staff (JCS), it is critical that these system standards be compatible with those of the other services. The Joint Interoperability Engineering Office (JIEO) of the Defense Information Systems Agency (DISA) is critical in the harmonizing of these specifications.

The overall network must provide connectivity within each of the BFA elements--maneuver, fires, aviation, Air Defense Artillery (ADA) and logistics, as well as cross BFA sharing of data, including real time combat information. Interfaces external to the digitized task force will include

the ATCCS of their command and provision to cross tell with flank elements of other organizations.

Given this system-wide approach to the digitized force, questions with regard to the incompatibility of IVIS and IDM will be resolved. In the near term, this may require a temporary "patch," but the sooner standards are established and enforced, the sooner the "seamless" Command, Control, Communications, and Intelligence (C3I) will be achieved.

As a logical extension of both the requirements process and definition of digitized standards, the Army needs to revisit the overall Army Command and Control System (ACCS) to insure the same level of operational consistency is achieved. On the basis of the magnitude of this task, the panel believes that business process re-engineering should be invoked to re-baseline ACCS. For a detailed discussion of re-baselining ACCS see Appendix B.

The accounting of artillery ammunition between AFATDS and the logistic system is an example where the process can be reengineered and probably streamlined. Our proposal would be to conduct a very intense review of all elements of ACCS (some 40 systems) in a bottoms-up analysis, over a period of about one year. This rather complex process is outlined below.

BUSINESS PROCESS REENGINEERING

Over the past few years the information management community has evolved a technology to identify a coherent set of requirements to support a given operation. This technique, known today as business process reengineering provides a structured approach to defining the processes to accomplish; helps to identify those areas that will benefit from automation; and provides a relatively simple, non-threatening environment in which the technologist and the operator can define their mutual needs. The application of business process reengineering to the ACCS could achieve three goals:

- Provide an automation plan which the operator can approve with reasonable confidence and understand what he is getting.

- Minimize possible redundancy among the BFA systems. For example, what is the proper relationship between artillery ammunition inventory in the AFATDs and the Combat Service Support (CSS) system? What data are needed by whom and where?

- Identify gaps in desired information flow between systems.

The automated tools which support the reengineering provide a critical bridge between the writers of the software and the warrior. In the past, the Army has described the requirements for complex C3I systems in a few pages, with none of the detail that describes the use and the products of the system to the software community. Likewise the technical establishment generates a series of specifications (A Spec., B Spec., and C Spec.) which are usually structured in terms of the partitioning of functions within the software which bear little or no resemblance to the operator's view of the combat support function. The panel believes that the lack of a common means of communication is a major impediment to the development of successful tactical automation.

Finally, considering the very stringent future funding constraints, it would seem appropriate to identify those functions which:

- can provide a major improvement in the ability of the force to fight, i.e., a baseline set of functions;

- are "nice to have" and can be deferred until the user has experience with the baseline and can better evaluate his real needs;

- are in the "too hard" category, for example:

  - A multilevel security (MLS) capability across the entire ACCS -- this technology will eventually be developed by users with much greater needs and budgets than the Army.

  - Near real-time imagery to tactical battlefield commanders. The limited communications capacity can be better employed to support the sharing of a common picture of the battlefield and to the provision of local situational awareness.

This "parsing of the users wish list," coupled with a complete business re-engineering analysis will result in the definition of a simpler, understandable C3I system which is supportable with available commercial technology.

The panel proposes that an expanded version of the Integrated Development Team (IDT) be established to conduct the re-baselining. This IDT would evaluate six distinct areas: Requirements and Systems Architecture, Data Definitions, Common Applications Software Systems (CASS), Common Hardware and Operating Environment Software (CHSII+) and the Communications infrastructure to support ACCS.

We would propose that each program office in the ACCS family be taxed for three or four individuals--to support the six IDT teams. The proposed breakout might be:

- The TRADOC System Managers (TSMs) and other user representatives, the system architects, would form a business re-engineering team for each major subsystem. After two months, all the components of the ATCCS elements would form the ATCCS re-engineering team to harmonize the subsystems into the overall ATCCS. Finally, all elements of the ACCS would form the ACCS group "until they got it right." This business reengineering process would result in a new class of requirement documents -- flow chart like structures that describe the data flow and define the processing required, and data base definitions that completely define the data to be provided to each node in the system.

- Individuals from each vendor, Program Manager (PM), and TSM office who work data would form the data standardization team which would be responsible for bringing the ACCS dictionaries into conformance with the DISA JIEO direction.

- All proponents of a Common Applications Software System form the CASS team. They would be provided a "laboratory" with workstations which could support software evaluation. This group would not see the light of day until a "common CASS" was agreed upon.

- System engineers from each component would form the CHSII+ team and would evaluate the candidate systems, including running their existing applications code before a source is selected.

- All communications engineers, signal personnel, data parsers, etc., would form a communications architecture team. They would be tasked to tie the multiple communications elements and their supported automation into a smart data exchange

system. In addition, the team should do an end-to-end review of the voice connectivity on the battlefield.

- These last three teams, CASS, CHSII+, and Communications would move into the laboratory environment for months six through nine to establish The ACCS Development Environment (TADE). All the elements defined by these teams would be integrated and documented to the satisfaction of the group.

The final steps in this process would be:

- Existing applications code would be brought into the laboratory and ported into TADE to demonstrate to both the operating environment team and the applications software group that a common environment had been achieved which is capable of supporting all applications.

- The requirements and business re-engineering team would meet with the applications software team to:

  - evaluate the utility of existing applications code; and

  - agree on the requirement to be met with existing code and the priority of development of new software to fill identified gaps.

- Finally the Data Element Group would present their data set to the Business Re-engineering Group and the Applications Software Group for suitability and completeness.

At the end of the year, the community would be in the position to redefine all elements of ACCS, based on the requirements defined by the process, with the added advantage that both the government users and developers will share a common perception of the problem with the vendors. This approach would move the ACCS from the realm of 30-40 different contracts/vectors to a common basis of design and implementation. Because of its "cleaner requirements" and commonality of hardware and software, it is likely to be much more affordable.

It can be argued that this re-basing team is overkill, too late, and/or unnecessary, but the history of Army automation clearly argues for this thorough review with sufficient rigor to avoid a continuation of a process that shows little sign of converging to the desired "Seamless Command and Control."

RECOMMENDATION 3

SIMULATION

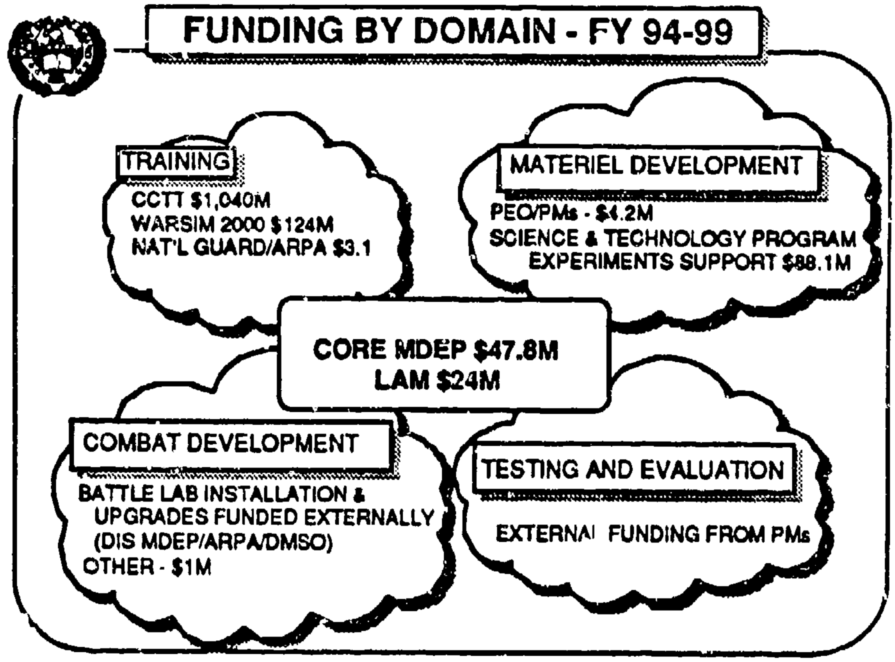
- EXPLOIT SIMULATION, LOUISIANA MANEUVERS AND BATTLE LABS IN EVALUATING THE MIX OF TECHNOLOGY UPGRADES AND NEW STARTS.
- MAKE SIMULATION A MAJOR FACTOR IN SYSTEM ACQUISITION AND TESTING TO SIGNIFICANTLY REDUCE COSTS AND TIME REQUIRED. INCREASED INVESTMENT REQUIRED.
- HAVE ARL AND STRICOM MANAGE R&D FOR ARMY-UNIQUE APPLICATIONS.

> "ADOPT A STRATEGY OF EXPLOITING TECHNOLOGY THAT IS DEVELOPED ELSEWHERE AND DO NOT INVEST IN TECHNOLOGY DEVELOPMENT FOR MODELING AND SIMULATION EXCEPT FOR ARMY-UNIQUE NEEDS."
>
> — Army Science Board Summer Study
> Army Simulation Strategy
> December 1991, p. 26

The availability of Distributed Interactive Simulation (DIS) and the TRADOC Battle Labs make possible the development of requirements for HTI, where detailed requirements can be examined in light of operational impact vs. cost to upgrade. The digitization of the fighting force is an example of a problem of such complexity, and the requirements for digitization should be thoroughly scrubbed using DIS. This evaluation through simulation will not only yield the technical parameters, e.g., information flow, but can also quantify previously conjectured performance, e.g., reduction of fratricide.

While DIS can be invaluable in evaluating and prioritizing the requirements for HTI, this recommendation should not be interpreted as placing DIS fundamentally in series with progress, rather that DIS is an important tool to be used in conjunction with other analytical and intuitive processes. Nevertheless, the Army should seek opportunities to apply DIS in operational testing and materiel development. This offers tremendous cost savings by sharpening both design and testing processes, by avoiding hidden flaws emerging only after a long development cycle, and by actually shortening the development and test cycle.

An important conclusion of the Army Science Board (ASB) study on Army Simulation Strategy was that only limited technology development is required where emerging simulation capabilities could not fully address Army-unique applications. In these cases, there should be strong management by Simulation, Training, and Instrumentation Command (STRICOM) and the Army Research Laboratory (ARL) to avoid duplication of model development, to validate models to be adopted, and to ensure uniformity in the selection of models for Army applications.



The ASB study on Army Simulation Strategy recommended that DIS be used for force development, training, material development, and testing. While DIS has been fostered in many applications, the use and acceptance of DIS by the testing and evaluation community has been slow. There appears to be the opportunity for tremendous cost savings in system testing by exploiting DIS.

The use of DIS cannot obviate the need for physical testing when real-world effects are not accommodated in simulations. For example, the reliability of a system or its susceptibility to jamming may be predicted by simulation at the component level, but the resolution of these simulations would be inconsistent with their inclusion in an operational-level simulation. Many such effects will require physical testing. On the other hand, the cost of a major field exercise is too large for such exercises to be used for all testing.

It must be recognized that field training exercises are also simulations of actual war. Field exercises and computer simulations differ in that each provides better fidelity in some modeled effects and less fidelity in others. Field exercises, for example, are encumbered with safety restrictions that would be nonsense in war; on the other hand, simulations of large operations are unlikely to be of sufficient resolution to reveal that battlefield dust can clog a poorly designed vent hole on a radio.

The real power of using DIS for testing is in the combination of DIS with field exercises or other forms of physical testing. Large-scale operations can be run many times using DIS, which would be prohibitive with field exercises. Beyond that, DIS could be used to help design the tests even when field testing has been selected; and DIS can also be used in the analysis of field tests.

RECOMMENDATION 4

ACQUISITION REFORM

CHANGE THE PROGRAMMING AND ACQUISITION PROCESS TO ENABLE ACCELERATED TECHNOLOGY UPGRADES BY:

- CONTROLLING GOVERNMENT OVERHEAD.
- REVISING THE FUNDING MECHANISM.
  - Create a subappropriation from part of WCTV, APA, MPA and R&D for Horizontal Technology Insertion (HTI)
  - Allocate R&D for performance upgrades and reduction of ownership costs for Vertical Technology Insertion (VTI)
- INSTITUTING A 2 STEP ACQUISITION PROCESS FOR HTI AND VTI.

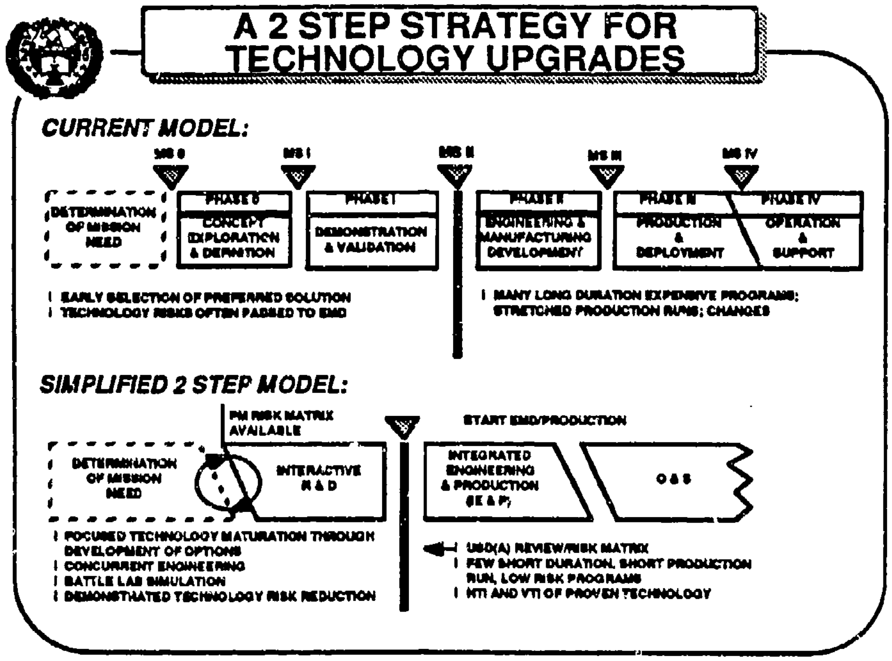
The Army requirements and acquisition process is currently encumbered with procurement regulations and practices that frustrate modernization of military hardware. It is apparent that inserting technology upgrades into operational platforms can be a highly cost effective means of improving military capabilities. Unfortunately, many hardware improvements are regulated by practices and specifications that impede the efficient, cost effective benefits available through horizontal technology integration and vertical technology insertion. Since the technology upgrade process can, in many cases, achieve substantially greater operational effectiveness than currently exists, it behooves the Army to reform the acquisition process in the following ways:

- Prescribed Government Overhead Goals for Each Project.
  The government overhead burdens carried by today's program managers strongly limit their ability to get greatest value for their allocated procurement dollars. It has been demonstrated in many DoD and Army studies that these burdens can be reduced by modifying procurement practices to alleviate these costs. It is important to note, however, that the cost benefits are related to the articles being procured and the position of the affected procurement within the products' life cycles. For these reasons, it is recommended that each program establish its unique cost savings goals within the Army-wide goal of a 30% reduction.

- A Revised Funding Mechanism.
  To assure identification and protection of funds, it becomes necessary to establish an appropriate system for providing budgetary resources for the acquisition of technology upgrades. For this reason, it is recommended that a sub-appropriation be established to support HTIs. These funds would be created from appropriate parts of Weapons Combat Tracked Vehicles (WCTV), Aircraft Procurement Army (APA), Missile Procurement Army (MPA), and Research and Development (R & D) accounts. These assets would be devoted to developing and procuring "B kits" to be incorporated into Army product lines which would be the hosts for HTI's. The product-unique "A kits," however, would be developed and funded by the product programs.

Another recommended funding mechanism involves the direct allocation of a portion of product procurement budgets for recurring R & D associated with upgrades. This money will be devoted to upgrading of products to improve their performance or reduce ownership costs through product upgrades which are unique to the system involved, i.e., Vertical Technology Insertion (VTI). It is recommended that, for planning purposes, an average of 5% of procurement funds be earmarked for this purpose.

- A Two Step Acquisition Process for HTI and VTI.
  Much of the poor cost and schedule performance associated with past programs has occurred as a result of not identifying, quantifying, and eliminating the technical risk inherent in new product developments. For this reason, a rigorous two-step acquisition process is recommended for technology upgrades.



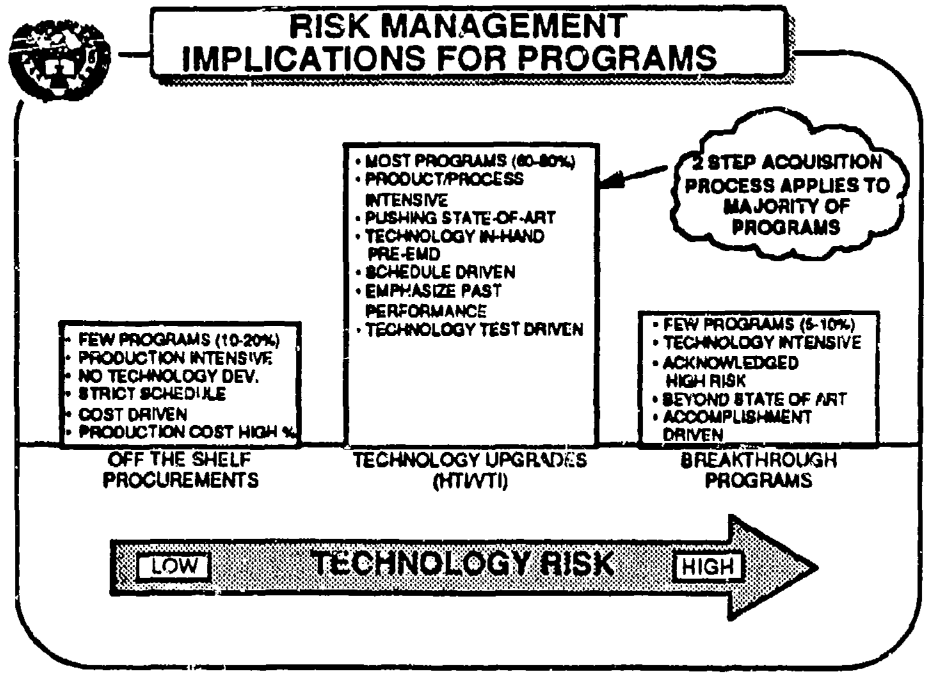
Before proceeding with the discussion of the recommended process, it is necessary to understand the "givens" of the acquisition situation.

Most important is an understanding that the single most frequent reason for program failure is the application of immature technology. This is entirely consistent with past studies, and in particular, with the "Betti" acquisition study where an empirical data base of several hundred programs clearly identified technology risk as the single most important cause of program failure.

Next, early identification and retirement of technical risk will require trust between parties—contractor and Army—Army and OSD—OSD and Congress. Without trust, open and honest assessment of technical issues is not likely to occur.

Third, it is entirely appropriate to point out that we <u>must</u> take technology risk to maintain supremacy . . . and that our real challenge is to manage this risk to acceptable levels, not to avoid it.

Fourth, some form of culture change should and must occur if we are to afford the technology upgrades we must have. A quality/cycle-time driven culture change can shorten schedules, reduce costs, and help in the process of restoring trust.



Before continuing with our recommendation on acquisition methodology, it is instructive to ask "What is it the Army is most likely to buy?" No- or low-risk off-the-shelf procurements are a small percentage of the total number of R&D programs.

Technology upgrades are the center of our procurements with HTI and VTI as dominant characteristics. Thus there will be technology risk present in the majority of these programs.

Lastly, it is appropriate to take higher risks on some programs which promise break-through capabilities and have a high urgency. These should be few in number.

As technology upgrades (HTI and VTI) are expected to comprise the bulk of Army programs, we recommend a technology risk reduction based, two step acquisition methodology as shown above.

The change called for here is a simple but major shift in the managerial paradigm. It recommends that the Army should focus on a two step acquisition methodology which can operate under existing DoD methodology and be accomplished within the Army's own prerogatives.

The entire focus is proving, via demonstrations, that the employed technology will perform to the necessary levels by the time R&D (the first step) is finished. The Government-Industry team does this with the full knowledge that:

- at the end of phase one, the technology performance parameters must be met or the program will be terminated, and that
- moving to Step 2 (actual integrated engineering and manufacturing development) with any technology risk still existing is unacceptable.

In this process, the technology risk is retired prior to production. To assure this is accomplished at program outset, all technology risk factors must be identified, and proof (demonstrations) of their risk reduction to satisfactory levels must be planned. To promote schedule and cost realism, contracts should be structured such that if these proof points are not satisfied, the contract automatically terminates. (The only exception would be a continuance decision by the Army Acquisition Executive.)

The primary features of the two step acquisition strategy are:

- The five phases of the current strategy are consolidated to two phases.
- Technology risk reduction is accomplished by the end of the first phase. If it is not retired, the program should not proceed.
- A major risk review point occurs (end of step 1) before major engineering and manufacturing monies are expended. This is accomplished using the risk matrix developed by the program manager during the first three months of the program.

Mission needs and R&D are interactive, employing digitization, DIS, TRADOC Battle Lab concepts, simulation, and demonstration.

Risk Reduction

The most fundamental risk that Army officials must manage is the risk that a system does not perform adequately in battle. If a device or machine does not work for its intended purpose, then the program is a failure. All the smart contract clauses and detailed testing are of no avail if we fail to ask the single all-encompassing question, "Does this thing do its job?"

The recommended two-step acquisition strategy focuses on this jugular issue. It is appropriate, then, to address some details of risk reduction, and make further recommendations for their implementation.

Tools to Manage Risk

The following management tool development is recommended.

- An Army/Industry PM team should develop a one-page risk identification format which will be filled out within three months of program start. This risk format will be used by the PM to track his status against performance specifications until the end of phase one, when it is available for Under Secretary of Defense (Acquisition) (USD(A)) review.
- A risk sieve or Red Flag list should be developed. Experience has shown many technology risk areas are common across many programs. This Red Flag list will help the PM attack most (but there is no promise of all) technological risk areas.

It is important that a team of Army/Industry PMs develop this list in order to capture the experience which exists. The four area groupings and examples are a product of our experience and intended for illustrative purposes, and as a basis for an action item:

Group I	Electronic Risk
Group II	Software Risk
Group III	Electromechanical Risk
Group IV	Materials Risk

As an example, electronics risk might include:

1. Any new or modified high power RF tube or transistor.
2. Any new process large scale integration (LSI) chip.
3. Any LSI chip with less than 2 micron feature size.
4. Any frequency synthesizer.
5. Any power supply employing chopper technology.
6. Any focal plane array.
7. Any charge coupled device (CCD) or infrared (IR) sensor.

Software risk might include:

1. Real-Time system.
2. Real-Time distributed system.
3. Real-Time Imbedded Microprocessor System.
4. Unique data bases.
5. Distributed data bases.
6. Relational data bases in Real-Time systems.
7. Dynamic resource allocation/on-line load leveling.
8. High number of source lines of code:
    a. Greater than 1,000,000.
    b. More than twice as many as in prior experience.
9. New hardware architecture or new software language.
10. Unfamiliar security requirement.
11. High PMFL requirements.
12. Lack of available alternative approaches.
13. Inappropriate requirements too restrictive for required functionality.
14. Portability of heritage code.

The application of these types of lists to any particular program would follow this thought process:

1. Do I have such a risk?
2. If yes, is it high risk?
3. If high risk, do I have a backup approach? When must I prove it to have a chance of recovery?
4. If low risk, nevertheless, I must schedule proof of performance before R&D is over. When does it best fit within the normal sequence of development?

This would be done for every Red Flag item even if the designer insists there is no risk (if such is the case, he'll have no trouble meeting the specs and schedule).

Cynics can now speculate if PMs will obfuscate or hide big issues. However, if we insist on a review of an original one page risk matrix and an answer to the questions, "Does this thing meet its operational objectives? Does it work?", the probability of avoiding Engineering and Manufacturing Development (EMD) with unproven technology is significantly enhanced.

Some probable questions about this approach:

- Does this mean we will build more prototypes than in the past? Probably.

- Does this mean we may need to use two or three technology alternatives to ensure risk reduction? Yes, sometimes.

- Are you telling me that all software operating systems must exist and be proven under load by the end of R&D? Yes.

- Will you accept simulation of traffic flows (both intra and trans system) as demonstration of proof? No, we need actual hardware and software demonstrations. We expect the use of simulation early in the program as a means of risk reduction and as a design tool.

- Will you accept TRADOC Battle Lab simulation as proof of operational performance to EMD? No, the Battle Labs are a necessity to establish operational need and provide a test bed for a program to interface. If there is technology risk associated with battlefield integration, you will prove it with actual prototypes.

There will be a thousand healthy questions spawned, the important thing is they will occur during R&D and not during EMD.

We recommend that we trust the Government Industry team to provide us a risk minimized system. The control on that trust is the single USD(A) review between phase one and phase two.

Last, we must recognize high turnover of personnel, and loss of "corporate" memory in both the Army and Industry. Some of this "lost" knowledge can be impacted by training. We recommend a Defense Systems Management College (DSMC) course in risk reduction specifically featuring the development of the red flag list, the summary risk matrix, and the use of DIS and the Battle Labs ... for combined Army/Industry attendees.

And last, it is appropriate to take higher risks on some programs which promise break-through capabilities and have a high urgency. These should be few in number.

RECOMMENDATION 5

RESOURCES

INCREASE FUNDING FOR ACQUISITION BY:

- REDUCING ACQUISITION PROCESS COSTS BY 30%
- CUTTING FIXED COSTS AND PROGRAMS
- REMOVING SELECTED OBSOLETE EQUIPMENT
- CONSIDERINGSELECTIVE MATERIEL READINESS REDUCTIONS

GOAL $2 BILLION PER YEAR

The integration of technology into existing and future platforms as the main modernization thrust will cost at least $8 Billion over the next 10 years as discussed earlier. This $800 Million a year should be financed from outside existing TOTAL Obligation Authority (TOA) within Acquisition to increase modernization funding to $12 Billion a year in the out years from 1996 and beyond to fund the mix of the few new systems, such as Comanche, along with the HTI and VTI upgrades to maintain land force dominance.

More can be done with the dollars to pursue HTI and VTI with the implied digitization of the battlefield need by:

- Continuing where the Research, Deveopment, and Engineering Center (RDEC) ASB study left off and applying the 1/3 reduction to all RDA infrastructure as was done for the RDECs.
- Scrubbing the 230 little programs for cuts to determine those that no longer fit the CONUS centric, contingency deployment, downsized Army. Fixed costs can be reduced by closures to unneeded facilities in the ammunition base.
- Retiring obsolete equipment such as old trucks and helicopters as recommended by the original Aviation Modernization Plan but overturned by Congress.
- Taking risk by lowering the materiel readiness required for later deploying units. We recognize that this is a very tough issue.

The sum of the above, which are not all inclusive, is to continue the restructure of Research, Development, and Acquisition (RDA) toward the reapplication of funding to be able to afford the promise of the technology upgrades opportunity by focusing on HTI, VTI, and digitization and rafting the resources from every possible pot to include increased investment by DoD to be able to continue to modernization. We understand that this is clearly not "business as usual."

RECOMMENDATIONS

• ACCELERATE HORIZONTAL TECHNOLOGY INTEGRATION (HTI) AND VERTICAL TECHNOLOGY INSERTION (VTI).	- Publish an HTI/VTI Modernization Plan - Appoint a General Officer to oversee HTI and VTI
• BUILD ON THE INITIAL DEMONSTRATIONS WHICH SHOW THE BENEFIT OF DIGITIZATION.	- Continue to press for an integrated system - Extend IVIS/IDM into other combat systems - Rebaseline Army Command and Control System
• EXPLOIT SIMULATION, LOUISIANA MANEUVERS AND BATTLE LABS IN EVALUATING THE MIX OF TECHNOLOGY UPGRADES AND NEW STARTS.	- Increase investment in simulation for systems acquisition and testing - Do not invest in technology development for modeling simulation except for Army-unique needs. - Have ARL and STRICOM manage R&D for Army-unique applications
• CHANGE THE PROGRAMMING AND ACQUISITION PROCESS TO ACCELERATE TECHNOLOGY UPGRADES.	- Control government overhead - Revise funding mechanism -- HTI subappropriation -- Allocate R&D for VTI - Institute a 2 step acquisition process for HTI and VTI
• INCREASE FUNDING FOR ACQUISITION.	- Reduce acquisition process costs by 30% - Cut fixed costs and 230 small programs - Remove selected obsolete equipment - Selective materiel readiness reductions

With resources tight and declining, the Army can no longer afford to continue to pursue the "new starts" approach to modernization of its combat systems. To afford the ability to keep its weapon systems current so that battlefield dominance will be achieved through overwhelming overmatch as was true in Desert Storm, the Army must come up with the right mix of technology upgrades and a selected few new starts.

The Army must accelerate its investment processes to motivate those in the development process to pursue technology upgrades in the form of Horizontal Technology Integration (HTI) and Vertical Technology Insertion (VTI). Every possible alternative to a new start must be wrung out. There is insufficient funding to procure an HTI as a product, put it in inventory, and issue it across several weapons systems. The major HTIs and VTIs will have to be, of necessity, procured against rigorously controlled standards and issued platform by platform, over time, and when affordable. The first generation common module Forward Looking Infrared (FLIR) approach is no longer the correct model for fielding the 2nd generation FLIR. However, allowing each weapons platform manager to buy and generate FLIRs that are not compatible with future procurements for other systems must be avoided. This is because interoperability will be achieved and costs will be saved.

Within technology upgrades (HTI and VTI), the major acquisition strategy for the 90s, the major enabling concept is digitization. Digitization is a process that converts Army systems from analog to digital. By establishing a systems architecture that captures the benefits of the information explosion now being exploited by industry, the Army can create a network and net the pieces together into an integrated whole that will save money and increase battlefield effectiveness.

In a like manner, the few new starts that are possible will have to be staggered. A selected few new starts will be needed for those Battlefield Operational Capabilities (BOC) where effectiveness can not be assured through technology upgrades to old platforms.

A new start is possible when there is a leap-ahead technology to be gained, when there are compelling operational advantages, and when the program is sufficiently attractive to gain

consensus with DoD and Congress. When a new start is selected, there should be provisioning for HTI and VTI to the new start program over time.

The companion enabling process to digitization is the wide use of modern Distributed Interactive Simulation—or DIS. This part of the vision for the 21st Century is the world of virtual reality. To be able to link simulations in networks that include the TRADOC Battle Laboratories will provide answers to combined arms interaction on the battlefield without the cost of putting large formations in the field. This will certainly enhance training and the development of doctrine and training. However, DIS does not stop there. The process also applies to materiel developments and testing. By wringing things out through DIS, the materiel developers should be able to design better equipment and avoid the huge expense of exhaustive physical testing.

To ensure DIS is all that it can be, we recommend that a vigorous Science and Technology (S&T) program be established in some combination of ARL and STRICOM.

To make this major shift in acquisition strategy from the new starts of the 70s and 80s to technology upgrades of the 90s, we believe the Government must realign its acquisition approach and deal with reducing its overhead.

We believe that the Army should pick up where the 1992 Army Science Board Fall RDEC study stopped and extend the 30% reduction in acquisition infrastructure across the entire acquisition base. In addition, government management cost goals should be established for each program with a target of a 30% reduction.

Also in the procedural area, there is the acquisition process change for risk reduction for the 80% or so of the programs that will be technology upgrades. We recommend a two-step process in which the risk is retired in R&D before any production is performed. Over 100 programs were studied by the Defense Science Board (DSB) during Mr. Betti's tenure as Defense Acquisition Executive, and most had problems successfully transitioning into production because the technology was immature. In the two-step process, if the risk is not reduced to an acceptable level at the end of Phase One, the program is canceled. Resumption of the program would only be possible if personally approved as an exception by the Army Acquisition Executive (AAE).

Also in the process area, the Army should adopt wherever possible, the best practices from the commercial world such as process certification and six sigma for quality. With the goal to reduce government overhead and the certification of the industry process, the Army can eliminate the large number of inspections and audits that slow the process down and cost up to a third more. For example, as in the case of the M1 tank program, when only 47 cents on the dollar flows to the prime contractor, something is wrong.

Finally, there is the issue of resources for investment in the mix of technology upgrades and new starts. The Army needs to increase and stabilize its investment accounts and avoid the use of them as bill payers for other accounts such as operations, maintenance, personnel, and training. This stability can come from a readjustment within investment accounts from infrastructure to systems as well as retirement of obsolete equipment and selective materiel readiness reductions.

By making these dramatic changes, the Panel believes the Army will gain momentum in its modernization process, ensure that Army weapons and support systems are maintained at overwhelming overmatch to ensure minimization of casualties, and be attractive for increased investment from DoD and Congress. We hope we have helped to reinforce the vision that becomes the legacy for the 21st Century.

APPENDIX A

TERMS OF REFERENCE
AND
PARTICIPANTS LIST

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, DC 20310-0103

13 APR 1993

Dr. Walter LaBerge
Chair, Army Science Board
23427 El Greco Drive
Mission Viejo, CA 92692

Dear Dr. LaBerge:

I request that you initiate an Army Science Board (ASB) 1993 Summer Study on "Innovative Acquisition Strategies for the 90s." This study should address, as a minimum, the Terms of Reference (TOR) described below. The ASB members appointed should consider the TOR only as guidelines and may include in their discussions related issues deemed important or suggested by the Sponsor. Modifications to the TOR must be coordinated with the ASB office.

I. Background. In the past, the Army Program Managers (PMs) managed all aspects of their programs. This system works well for development of new weapon systems, but makes insertion of new technology uniformly across several different weapon systems very difficult. In the future, declining budgets will require that the Army reduce the number of new weapon system developments and, instead, emphasize technology insertion to upgrade current systems so we can maintain our fielded technology edge.

Winning edge battlefield operational capabilities such as Combat Identification, Command and Control on the Move, "Owning the Night," and Chemical-Biological Defense can only be achieved effectively by inserting the enabling technology "horizontally" across the warfighting force, i.e., by insertion into affected existing systems and/or relevant new systems. The Army must improve its ability to insert technology into existing systems across the force via upgrades. It must institutionalize horizontal technology integration in the acquisition and supporting Planning, Programming, Budgeting and Execution System (PPBES) processes.

In addition to horizontal technology integration, the Army must accelerate the retirement of tactically and/or logistically obsolete systems which impose high costs of ownership and/or are unlikely to have a wartime mission. We must establish a practical policy and procedure to invest the resources saved by early retirement of such equipment in Army modernization.

Finally, the Army must seek other innovative methods to allow us to modernize in a period of sharply reduced resources. Incentivizing the acquisition process to manage risk, rather than minimize or avoid risk, should reduce costs, reduce the time from concept to fielding (i.e., "time to market") and encourage technology innovation vice obsolescence.

II. Terms of Reference.

a. Identify the highest pay-off, practical Battlefield Operational Capabilities for which horizontal technology insertions into existing systems should be pursued.

b. Identify a management scheme and/or changes to the existing PEO/PM organization which would facilitate horizontal technology insertion.

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c. Identify current Army systems that could yield substantially improved capabilities through horizontal technology insertion upgrades. Estimate the cost and schedule of technology insertion programs for each system. Also identify those major systems or classes of systems for which horizontal technology integration is either not practical or not cost effective.

d. Suggest approaches for best utilization of Battle Labs and advanced distributed simulation to evaluate horizontal technology insertions.

e. Suggest methods to optimize rather than minimize risk in order to accelerate the acquisition process and get equipment into the hands of soldiers faster. Identify specific programs that are candidates for accelerated acquisition. Make specific recommendations on how to better acquire information technology.

f. Identify technical, organizational, regulatory, statutory or other limitations and appropriate changes to include specific changes to the DODD 5000.1 and 2 Series that could:

- Enhance maintaining our winning edge via horizontal technology integration across Army systems.
- Accelerate the retirement of tactically and/or logistically obsolete equipment/systems.
- Permit accelerated development and fielding of new systems with reasonable risk and low cost.
- Realize the full potential of Advanced Distributed Simulation to streamline the acquisition process.

g. Estimate the approximate cost and appropriate timing for technology insertion programs into new weapon system development.

III. Study Support. The Assistant Secretary of the Army (Research, Development and Acquisition) will Co-Sponsor the study with MG Jay M. Garner, Assistant Deputy Chief of Staff for Operations and Plans - Force Development. The Cognizant Deputy will be Mr. George T. Singley III, Deputy Assistant Secretary for Research and Technology. The Army Staff Assistant will be Ms. Sharon Vannucci.

IV. Schedule. The Study Panel will begin its work immediately and conclude the effort at the ten day summarization and report writing session scheduled for July 19 - 29, 1993 in Monterey, California. The time and location of other meetings will be coordinated by the Staff Assistant and Study Chair. As a first step, the Study Chair should prepare a study plan for presentation to the Sponsor and Executive Secretary.

V. Special Provisions. It is not anticipated that the inquiry will go into any "particular matters" within the meaning of Section 208, Title 18 of the United States Code.

Sincerely,

George E. Dausman
Acting Assistant Secretary of the Army
(Research, Development and Acquisition)

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APPENDIX B

SYSTEMS UPGRADES

APPENDIX B
SYSTEMS UPGRADES

MISSION AREAS AND INDEX	
Close Combat Heavy, B-01	Logistics, B-50
Command, Control, Comm, B-12	Aviation, B-52
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CRITERIA.

The Army has many major systems in the field and others in various stages of acquisition. Some of them, but not all, are attractive candidates for technology insertions. Several criteria were used to judge whether a particular system would be considered a continuing candidate for technology insertion. Those used to winnow the list of systems, <u>within each mission area</u>, are shown below.

CRITERIA	
#	IS SYSTEM A CANDIDATE FOR TECHNOLOGY INSERTION?
1	NO -- System is fielded but not an Army system.
2	NO -- This mission area not principal system application. [But attractiveness for upgrade elsewhere assessed for principal mission.]
3	NO -- System is seen to not have capability shortfalls needing correction.
4	NO -- System is fielded and no technologies are apparently available whose insertion would upgrade the system to needed level of capability. [A follow-on replacement system may be indicated.]
5	NO -- System is expected to not remain in service long enough after any potential upgrade [nominally at least eight years] to warrant the effort.
6	NO -- System fielding uncertain and too far in future to be of interest now.
7	YES -- System not fielded; capabilities should be incorporated in ongoing development.
8	YES -- System fielded and none of the disqualifiers above apply.

Insertion would be by retrofit for fielded systems; by incorporation in development systems.

CLOSE COMBAT HEAVY SYSTEMS.

The Close Combat Heavy (CCH) items in this section are taken to be all the mechanized infantry, armor, combat engineer, air defense, and direct support artillery armored systems that operate in the close combat portion of the battlefield.

<u>Systems Considered</u>. The systems considered were those mentioned in Annex A of The Army Modernization Plan. They, together with the results of the first winnowing, are as shown in the Table below. A strike-through line indicates that the system was set aside as not a candidate, based only on its role in close combat operations, for technology insertion. The reasons for the set aside, keyed to the riteria Table above, are also shown.

CCH SYSTEMS CONSIDERED			
HMMWV SCOUT	8	TANK M1A1	8
~~FSV~~	6	TANK M1A2	8
IFV M2A0	8	~~TANK M1A(?)~~	6
IFV M2A1	8	~~FMBT~~	6
IFV M2A2	8	~~CEV M728~~	5
~~FIFI~~	6	~~AVLB M60~~	5
CFV M3A0	8	TRV M88A1E1	8
CFV M3A1	8	HAB (M1)	7
CFV M3A2	8	CMV (M1)	7
BRADLEY STINGER	7	ACE M9	8
~~ITAS~~	3	~~SP HOW M109A5~~	5
~~JAVELIN~~	3	SP HOW M109A6	8
~~NLOS~~	6	AFAS	7
~~LOSAT~~	6	FAARV	7
STINGRAY	7	~~C2V M577~~	5
~~APC M113A2~~	5	C2V (MLRS CHASSIS)	7
120 MORTAR M1070	8	ATACS	8
AEI	8	AGS	7

As seen in the Table above, many CCH systems, and several models of some of them, were not ruled out. These were identified as continuing candidates for technology insertion.

Systems Discussion. The several CCH systems not ruled out operate in the forward, and probably the most dangerous, part of the battlefield. Although in the same environment, the systems have different roles as parts of a combined arms team. They need to be controlled together, to move together, to fight together, and to survive. Upgrades that enhance these abilities, especially ones that remove operational incompatibilities, would be especially beneficial.

Systems Limitations and Promising Technology Insertions. The current US. Army heavy systems have impressive, perhaps even unequaled, close combat capabilities. They also have capability shortfalls that to advantage can be lessened by insertion of advanced technology subsystems The first to be examined are shortfalls common to several types of systems for which remedies could be applied. After that, selected upgrading of single systems is discussed.

Horizontal Technology Integration (HTI) Opportunities.

- Identification Friend or Foe (IFF).

  Close Combat Heavy weapon systems have long needed, but not had, effective means of identifying detected objects. The several fratricide incidents in DESERT STORM focused attention on the needs and resulted in increased efforts to meet them. A program to improve matters is now underway.

  For use in the near-term, a variety of cooperative passive devices are to be placed on CCH (and other) systems giving them distinctive signatures observable by, at least, friendly shooters. The initiative, known as Battlefield Combat Identification System(BCIS), appears to be a practical, on-going, example of HTI. The adopted solutions probably will be more effective and less expensive than would have occurred had the problem been worked for each shooting system independent of the others. The selected solutions, which can be fielded in a short time, should be quite inexpensive. They nicely exploit near-term differences in the features of the target acquisition systems used with friendly and (most) potential adversary weapons. On the other hand, they do not

provide a solution that can be expected to endure. Moreover, one can imagine ways in which suitably equipped future opponents might use our passive BCIS devices to the disadvantage of our elements. Something more than the near-term approach is warranted.

For use beginning in the mid-term, development of a millimeter wave (MMW) inquiry-response cooperative active system is just now about to begin. The approach being supported for the mid-term promises to be more robust than that of the near-term solutions. On the other hand, its costs will be considerably higher, and there should be concerns over the intrinsic "fail unsafe" feature of any system where absence of a correct response to an inquiry will be interpreted as evidence that the interrogated is not a friend. The examination here has not been in near enough depth to support an argument that the selected mid-term solution is inferior, overall, to other available options. However, there are alternatives. For example, one could have used a laser-based inquiry/response system or, possibly, a system that would exploit the information, to be in the tactical C2 system, regarding the location of all friendly elements in the vicinity of a particular shooter.

For the far-term, other technical approaches, mainly uncooperative passive in character, are being considered. So far as has been determined, there is as yet no indication of any dominant solution.

A final point to be made is that whereas all CCH systems need to have the passive panels of BCIS, they do not all need both elements of the Inquiry/Response system being acquired for the mid-term. The only systems needing the inquiry transmitters are those having the direct or indirect (e.g., artillery fire controller) capability to deliver fire; the ones needing the response device are those that might be engaged by friendly fire. Obviously, some systems need both.

The overall assessment here is that the **Battlefield Combat Identification Systems**, and a mid-term device, should be accepted, as they are now accepted, as well suited for Horizontal Technology Integration in CCH systems.

- Position Location and Navigation, Heading Reference and Reporting.

All CCH systems need an automated on-board means of self-location in reference to a common geodetic reference. Experience with GPS devices in DESERT STORM demonstrated the benefits. They also need an automated means to report their current position via the tactical radios. Some need a heading reference system i.e., a compass.

The needs are far from uniform. For example, the artillery Fire Support Team Vehicle (FISTV) can not tolerate errors in position location and heading reference that would be quite acceptable to the operator of the tank. The implication is that while all need devices to perform the functions, all the devices need not be identical. The differences in costs among different pos/nav systems adequate to the differing specific system needs like will prove to be large compared to the benefits of using a single type position/navigation (pos/nav) device for all systems.

There are several technical means of meeting the operational needs. For CCH system application, the more attractive approaches either exploit radio emissions and/or use mechanical or laser gyroscopes.

- The **EPLRS** radio nets are capable of determining position location, of reporting it, and of transferring limited digital data messages. The position location feature is an intrinsic, nearly "free", feature once one pays for the net for digital data transfer. A processor uses precisely timed receptions from several transmitters on the ground radio net to determine the location, but not bearing, of the receiver. EPLRS units are expensive. Their use has been hard to justify in applications not demanding its digital data transfer capabilities. Fielding in substantial numbers in the Army now appears doubtful. Air defense units have been seen to need both EPLRS and its bigger brother, JTIDS, to distribute real-time threat track data among multiple elements of the defense. Presuming these nets in place, elements of the air defense then could use them for position location and reporting. This will not be the case for other CCH systems. They, on current plans, will not use EPLRS radios and therefore will not have "free" position location.

- In the **GPS** system, an embedded processor uses the time-of-arrival emissions from at least four GPS satellites from a constellation of about two dozen to determine the three-coordinate position, but not (for a single receiving antenna) bearing, of a GPS receiver. For a variety of reasons, the constellation of GPS satellites has already been placed in orbit and will be maintained. At this time, their emissions are like manna. GPS receivers have proven to be both extremely rugged and inexpensive. The derived position accuracy is good enough for CCH system. GPS reportedly also can use two separated antennas, in a "differential" interferometer mode to get a (not very precise) heading indication, or alternatively, a non-GPS heading reference, such as a single axis gyro, can be used in applications where more precise bearing information is needed. Concerns about GPS satellite survivability and receiver ECM jamming appear to have lessened in the post Cold War threat environment. The susceptibilities remain.

- A laser gyro-based system called **MAPS** provides both position and bearing information. Being autonomous, it is robust to both ECM and ASAT and provides the highly precise location and bearing data needed by artillery for long-range indirect fires. On the other hand, it tends to be too expensive for proliferation to those CCH systems not demanding its high performance.

- A **low-cost mechanical gyro**-based system, such as that used in the M1A2 tank, can also provide both location and bearing data sufficient for some applications. The accuracy of location and bearing is well below that of MAPS, but with periodic updates from, say an external GPS or MAPS or a map, they apparently are adequate for tank applications.

Clearly, there are several ways for CCH systems to perform the function of self-location. However, since the position and heading accuracy demands so differ among the CCH systems, there are good economic reasons why it may be best to use more than a single type of product. Selection of the preferred position locator(s), and distribution of it (them) to the key items in the Close Combat Heavy force, appears to be now feasible, practical, and affordable. The Army should proceed to field these devices as part of a single Horizontal Technology Integration initiative. Once the self-location data is in hand, it, of course, can be passed to needing elements of the force. The wrong way to do this is the way it is now done, i.e. by voice communications on Combat Net Radios. The right way is by an automated digital input into a modern tactical digital C2 system.

- Day/Night Target Acquisition Sensors.

CCH systems need, but do not now have, means for battlefield observation, and for target acquisition, day and night, out to the limits of weapon reach or terrain mask.

The first generation FLIR systems have provided major benefits in both day and night operations. On the other hand, their target acquisition ranges generally are well short of those needed, especially during periods of marginal weather. For example, the FLIRs used with ground TOW mounted on Bradley vehicles and HMMWV have, in somewhat less than ideal weather conditions, a nominal target recognition range of, say about 2000-2500 meters—less than two-thirds the nominal 3750 meter maximum flight range of the TOW missile. The first generation FLIRs also have serious shortfalls in resolution and supportability.

The **Second Generation FLIRs**, which use currently available scanning focal plane array technology, offer an attractive means of meeting the functional requirements implied by the operational needs. They would provide performance clearly superior to that of the first generation FLIRs in all three problem areas. For example, FLIRs having effective ranges exceeding those of first generation systems by something like 50%-100% can be had while remaining within comparable size, weight, and aperture constraints.

As was the case with first generation FLIRs, design modularity will permit commonalty of major components for second generation FLIRs applied to different platforms. This will result in economy-of-scale benefits. Of course, some other FLIR components will have to be tailored to fit the needs of the platforms. The new FLIRs also will be well-suited to integration of automatic

target tracking, a fire-control feature that should improve accuracy of engagement of moving targets. These second generation FLIRs will not be cheap, but their added capabilities appear to warrant their cost.

It is understood that the Army currently is setting the technical standards for these second generation FLIRs and sorting out application priorities. Acquisition is to accomplished in a coordinated Horizontal Technology Integration program. All of this is here viewed as the right approach. The Army is encouraged to proceed as planned. As it does so, one of the matters certain to arise is which of the ongoing FLIR acquisition efforts should be "grandfathered." (The view here is that each such case should be decided on its merits, that it would be wrong arbitrarily to suspend ongoing programs—might ITAS not be one?—that do not fit neatly in the now to be supported HTI effort.)

- Tactical Command Control Digitization.

Each major platform system in the CCH portion of the force should be at the right place at the right time doing the right things, i.e. executing action actions in accordance with the Commander's Concept of Operations. To enable elements to more closely approach that ideal, each system of the CCH force needs a common picture of the battlefield, its terrain, and the dispositions of friendly forces. Each needs knowledge of its own location as well as the location of friends and enemy elements in the vicinity. Each needs a rapid, easily comprehended, and error-free way of passing mission orders and control measures. Each needs information regarding self-status. Command and staff elements need information regarding status of subordinates.

These operational needs are not new, but practical means for meeting them are new. The application, "bottoms-up," of modern digital systems technology to improve control of the item systems, platoons, and companies of the Battalion/Brigade level combined arms task force promises major operational gains. This tactical C2 digitization is seen as a prime example of what needs to be done for the most directly engaged elements at the lowest levels of the force to meet the Army's modernization goals of "Win the Battlefield Information War" and "Dominate the Maneuver Battle."

Despite the fact that all CCH elements need the capabilities noted above, their needs are not identical. For example, it is less important that the crew of an M88A1E1 VTR system have precise information regarding control boundaries and phase lines than the crew of an Abrams tank leading an assault. Thus, as is the case for pos/nav systems, the tactical C2 digitization system will best be tailored to the platform application.

The envisaged means to perform the functions implied by the operational needs stated above consists of two parts. Part one is the "intra-system" part. It is a digital information system to be resident in each of the item systems. This "intra-system" part is seen to be comprised of 1) a linked ensemble of digital subsystems that perform the set of functions common to all CCH systems, and 2) such other system-peculiar digital sub-systems as may be appropriate to the particular system. Part two is the "inter-system" part. It is seen to be a wireless communication network used to transfer digital data among the systems of the force, together with all the algorithms and software used for net control and data distribution.

Realization of the "intra-system" part of the envisaged tactical C2 digital system probably can be done best at, say, three levels. At Level I, a means would be provided to couple the output from the pos/nav system to the tactical radio, a heading reference, a modest digital processor, a limited I/O device, and not much more. This would enable the crew of, say, a CEV, to know its location, to report it automatically so that others could also know, to navigate to a new location, and to receive digital messages. Level II systems would be needed for most CCH vehicles—especially fighting vehicles and C2 vehicles. They should have a nominal set (specific items may be omitted from selected systems if not needed) of digital devices as listed below together with a few comments regarding applicable technologies.

- Digital Processor(s). Commercial microprocessors, suitably hardened and packaged, will suffice and will be best. Computer sizing will, of course, vary widely among the several systems depending on processing loads.

- Man/Machine Input Device(s). Custom Input Panels, Touch Screens, and Voice Input Devices are among the several options for enabling crews to place data in the digital information system.

- High Resolution Visual Display(s). To enable the soldiers to understand the information to be in their computers, all CCH systems should have high quality color displays. Visual presentation of terrain in electronic maps, self-position and bearing on that map, locations of friends and foe in the vicinity, mission objectives, operational plans, control measures, and system status data are among the information to be displayed as called.

- Digital Data Mass Storage Unit. Hard Disks, Optical Disks, and Flash Memories will be available to store a few gigabits of data. Among the largest files will be the terrain data used to generate the electronic maps.

- Busses/Back Planes/Hardwires. Each type of CCH system should have its own combination of point-to-point hard wiring and busses to interconnect the above elements and such others as may be included. For most CCH systems, the now dated 1553B bus at 1 MB/S will suffice for the first increment system. Other standard busses, i.e. "SAVA-like" at about 20 MB/S, can be used should internal data transfer rates require the higher capacity. The VME back planes seem appropriate, but others can be used if superior. The key is standardization to facilitate integration of items such as the various elements of VIDS discussed below.

- Position/Navigation Unit. This can be any one of the pos/nav systems discussed in paragraph 3 above together with an interface unit to input digital data into the "intra system" part of the digital C2 system.

- Automated Radio Interface Unit. This "black box" is to enable information resident in the "intra system" information system to be passed digitally to the "inter system" information network, and to receive information from it.

At Level III, ensembles would integrate a variety of other digital devices. Examples include fire-control systems, prognostics and diagnostics, selected VIDS elements discussed below, voice I/O devices, embedded training devices, system status monitors, etc. As a rule, it usually will be best to retrofit existing systems having analog controls with Level I or Level II products, leaving Level III products for application to new production systems such as M1A2, M2A3, AFAS, etc.

- Survivability Suite.

All CCH systems need enhanced survivability. The spectrum of threats includes the traditional kinetic and chemical energy direct-fire-weapons as well as guided missiles, mines, artillery rounds, and air-launched ordinance of multiple types. The **Vehicle Integrated Defense Suite (VIDS)** program that has been underway at TARDEC has identified a number of appliqué armors, signature reduction kits, sensors, and defense mechanisms that could be used on the CCH systems. These VIDS elements aim to frustrate acquisition by opposing systems, to degrade opposing weapon's delivery accuracy, and to reduce impairment of CCH vehicles when they are hit. The number of optional VIDS sensors and defense mechanisms is, like the number of optional forms of attack, impressively long and, as shown in the table below, costly.

VEHICLE INTEGRATED DEFENSE SUITE			
SENSORS		**DEFENSE MECHANISMS**	
LASER WARNING	$40K	LASER FALSE ALARM GEN	$10K
RADAR WARNING RCVR	$70K	RF JAMMERS	$100K
MSLE. WARN. RCVR	$70K	MULTISALVO SMOKE	$15K
NON IMAGING SEN.	$50K	ACT. PROTECT	$80K
ACT. PROTECT RADAR	$300K	OTHERS	????

It appears that all VIDS components could not be afforded for most CCH systems. Instead, tailoring to respond selectively to specific threats seems inevitable. Indeed, specific sensors and defense mechanisms might be developed and put "on-the-shelf" pending hard evidence of threats warranting production and fielding. The Army may find that introduction of elements of VIDS would be best done by defining a number, say three, "packages". Package One might include Multi-salvo smoke, Laser Warning Receiver, and Laser False Alarm Generator, i.e. responses to threats that are accepted as already widely deployed -- i.e. tank guns and infrared guided missiles. Package Two would be Package One plus selected other specific countermeasure devices -- short of the active protection system, as was judged to be warranted by hard evidence of threats. Package Three, which most probably would be limited to a few high value systems unable to suppress signatures, would consist of Package Two plus the Active Protection Radar and Active Protective System. AFAS may well be in the category of systems wanting Package Three.

A feature of VIDS worth noting is that (most of) the sensors and defense mechanisms require systems integration and control that would best be accomplished by coupling to the "intra-system" portion of the digital C2 system. This 1) argues for early identification of the interface characteristics of the "intra-system" portion of the digital C2 system, 2) makes more attractive the use of a bus architecture vice exclusively point-to-point hard wiring, and 3) puts a premium on maximum commonalty of busses among the several CCH systems.

Multiple Project Managers, multiple industrial firms, and multiple government organizations will be involved when these items are integrated on existing CCH systems -- the management challenges promise to be not less than the technical ones.

- Accurate Lethal Munitions.

Tanks need a munition that is more accurate and lethal than current rounds at long engagement ranges. Two passive homing munitions having autonomous target acquisition capability, STAFF and X-Rod, now are in development. The Army, at the right time, but not much later than now, should pick one of these and complete its fielding. Continuing with both seems unnecessary and is apt to result in neither being realized. Between the two, one factor for consideration should be the utility of the technology to other applications.

The 120MM mortar needs a round that can hit and disable small moving armored vehicles. Foreign firms have developed smart rounds for mortars. The Army should assess these items to determine whether they are suitable for adoption as NDIs without significant modification. If so, they should be bought; if not, they should be forgotten.

For some time, SADARM has been in development for delivery by the 155MM Howitzer and MLRS. This sensor-fused munition uses a explosively formed kinetic energy penetration to top-attack armored vehicles.

The needs for an improved seeker for the Stinger missile is discussed in paragraph 2.xx below. It is mentioned here only because the BFV (Stinger) is considered a CCH item. Wherever the discussion, what is clear is that improvements in Stinger's ability to deal with air threats in ground clutter.

Each of these **Brilliant Munitions** promise improvements in long range, accurate, lethal, "fire-and-forget" firepower with reductions in the tonnage of ammunition required -- improvements much needed for the operations envisaged for the future.

Technology Insertions.

- Rangefinder and Fire Control System.

Bradley systems need a range finder and a fire control system more capable than that currently provided. Lack of the ability to determine accurately the location of an acquired target degrades gunnery, as does lack of a capable fire control system. Moreover, imprecise location of detected objects precludes placement of dependable target information in a C2 system for exploitation by others. Many CCH weapon systems (tanks, attack helos, fire support systems) have these items, but Bradley systems do not. The needed rangefinders and fire control systems pose no previously unmet technical challenge. Laser rangefinders, at several different wavelengths, providing adequate performance, have been successfully fielded on other systems for more than a decade. The issue has been whether the needs warrant the costs, not whether technology is available. Now, the needs are more clear and the costs are, perhaps, lower. In any case, the view here is that these items should be integrated into Bradley systems. (It is understood that these items now are part of the Bradley upgrades that resulted from experiences in Operation Desert Storm.)

- Compatible Mobility.

Other CCH vehicles need the ability to move in concert with the Abrams tank and Bradley fighting vehicles. Several, such as the M577 C2 Vehicle, still use M113-based chassis components. Others such as the AVLB and the CEV are on M48/60 chassis. All of these need to be upgraded to the superior mobility of the BFV and Abrams tanks. Whether the efforts are to be viewed as "new starts" or "technology insertion" is somewhat arbitrary. Here they are treated as ongoing new production systems and not further discussed.

- Tank Major Subsystems.

In the fullness of time, there will be a pressing need for major upgrades in tank power train, suspension, armament, ammunition loading, and armor. A central problem of tank modernization programs always has been the difficulty of justifying development of these major subsystems to retrofit existing tanks, or to enable an uncertain future one. An even more difficult challenge has been development of a new tank absent new generations of these subsystems. Which, if any, of these new subsystems should can be fitted to the Abrams tank as upgrades is unclear. To use them, the changes to Abrams could be large. Moreover, several of the subsystems, i.e. power train, armament, and auto loader, might have to be introduced altogether.

- Engine/Transmission.

The **AIPS** is to be a new integrated engine and transmission that is much smaller and more fuel-efficient than those now in the Abrams tank. Transverse mounting will free valuable hull space. This freed volume then could permit component relocations and, for example, enable use of a more powerful main gun.

- Main Armament.

ATACS is a new solid propellant tank gun/ammunition system having considerably greater muzzle energy than previous tank cannon. Its principal virtue is that it would have the ability to fire

projectiles capable of sure defeat of any foreseen future armored targets. Development started several years ago but work has been slowed by lack of consensus that the gun would be suited to tank use and, more audibly, by unavailability of funds. Some work also continues on the enabling technologies leading to ElectroThermalChemical and electromagnetic weapons. It is too early to say when, or perhaps even whether, either of these approaches will support development of a tank main armament, but their promise warrants continuation of development efforts.

• Automatic Loader.

This a subsystem, which apparently has remained unnamed, can increase tank rate of fire and reduce tank crew size by one person. Automatic loaders are in Soviet tanks and the US Armored Gun System. One will be in AFAS, the new US Howitzer. Each design is application unique, but satisfactory operation now has been demonstrated. Because its design is always so application specific, work on this component probably should await definition of its parent system.

• Suspension.

A **Hydro-pneumatic External Spring and Damper** system that performs the function currently performed by torsion bars, but without the demand for internal volume, is being developed. These probably will not be suited to retrofit on Abrams, but conceivably they might find use on some later version (will there not at sometime be an M1A3?). Similarly, a **new track** for increased endurance has been designed and built and now, it is understood, awaits testing. The opportunities for single system technology insertions are shown in the Table below.

CCH OPPORTUNITIES FOR TECHNOLOGY INSERTION -- SINGLE SYSTEMS

TANK	BFV	HAB	CEV	C2 VEH
AIPS ATACS SUSPENSION	RANGE FINDER FIRE CONTROL	M1 CHASSIS	M1 CHASSIS	MLRS CHASSIS

The table below arrays the Horizontal Technology Integration opportunities versus the CCH systems for which their application is assessed to be appropriate. Note that for some of the proposed HTI initiatives, various levels of application are envisaged. This is in accord with discussions above. Note also that this Table includes rough estimates of the number of systems that would have to be acquired to equip the Force Package One portion of the Mid-Term Army. This number of systems, together with the number of systems identified for other mission areas, are combined and costed in a later portion of this report.

CCH HORIZONTAL TECHNOLOGY INTEGRATION OPPORTUNITIES														
SYSTEM:	SCOUT	TANK	BFVS	AGS	STINGRAY	BFV AD	BFIST	C2 VEH	SPHOW M109A6	120 MM MORT	VTR M88A1 E1	HAB	CEV	ACE M9
NUMBER:	510	1928	2576	58	XXX	XXX	253	XXX	425	404	329	302	563	379
IFF - NEAR TERM - MIDTERM	P L, T	P L, T	P L, T	P L, T	P L, T	P T	P L, T	P T	P T	P T	P T	P T	P T	P T
POS/NAV, HEADING REF, RANGE FINDER	GPS INERT. OK	GPS INERT. OK	GPS INERT. OK	GPS INERT. OK	GPS-INERT.? ?????	EPLRS INERT ?????	MAPS MAPS OK	GPS INERT //////	MAPS MAPS //////	GPS-INERT //////	GPS-INERT //////	GPS-INERT //////	GPS-INERT //////	GPS-INERT. //////
2ND GEN FLIR(S)	YES	YES	YES	YES	YES	YES	YES	\\\\\\	\\\\\\	\\\\\\	\\\\\\	\\\\\\	\\\\\\	\\\\\\
C2 DIGITIZATION	LEV III	LEV III	LEV III	LEV III	LEV III	LEV III	LEV III	LEV II	LEV II	LEV II	LEV I	LEV I	LEV I	LEV I
BUSS OR HARDWARE RADIO INTERFACE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
DIGITAL PROCESSOR MASS MEMORY INPUT PANELS HI RES DISPLAY	YES	YES	YES	YES	YES	YES	YES	YES	?????	FDC	//////	//////	//////	//////
VEHICLE CONTROLS	//////	M1A2	//////	//////	//////	//////	//////	//////	//////	//////	//////	//////	//////	//////
PROG/DIAGNOSTICS	//////	M1A2	BLK III	//////	//////	//////	//////	//////	//////	//////	//////	//////	//////	//////
TRAINING AIDS	//////	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	//////	//////	//////	//////
SURVIVABILITY SUITE	PKG I	PKG I	PKG I	PKG I	PKG I	PKG I	PKG I	PKG I	?????	PKG I	PKG I	PKG I	PKG I	PKG I
LASER WARNING M.S. SMOKE I R JAMMER	YES	YES	YES	YES	YES	YES	YES	YES	?????	YES	YES	YES	YES	YES
OTHER CM DEVICES	DEV	DEV	DEV	DEV	DEV	DEV	DEV	DEV	?????	//////	//////	//////	//////	//////
BRILLIANT MUNITIONS	\\\\	STAFF OR XROD	\\\\\\	STAFF OR XROD	\\\\\\	NEW MISSILE KE	\\\\\\	\\\\\\	SAD-ARM	SMART RD	\\\\\\	\\\\\\	\\\\\\	\\\\\\

Acquisition Implications.

In the preceding paragraphs, emphasis was on interesting technology insertions, the systems that should receive them, and the number of needed items. We turn now to how they should be acquired and, in general terms, from whom they should acquired.

The several items suggested can be sorted according to the most suited type of acquisition using the ideas presented in Recommendation 4. Here, it is enough to rememeber that Program. Type I is to acquire technology and process knowledge, not a product; Program Type II is to acquire a breakthrough system; Program Type III is to acquire an evolutionary system; and Program Type IV is to acquire an "off-the-shelf" system.

The products of principal interest here are items that must be both acquired and integrated into existing systems or ones being developed. It is proper to consider who, in a general sense, should develop and produce these products and who should integrate and install them in the host systems. The view here is that, possibly with a rare exception, it will be best that the system Project Manager and his prime contractor have overall responsibility for integrating HTI and VTI products into major systems. To do otherwise would entail unacceptable loss of system configuration control and accountability. Thus, the prime contractor is seen to be, in most cases, the contractor for integration and installation activities. On the other hand, the developer/producer of the HTI and VTI products should be selected on the basis of best value to the government, taking special account of to include consideration of the Program Type. Of course, the Project Manager responsible for a particular HTI or VTI item will have to coordinate extensively and agree to detailed interface controls with those responsible for all the host systems into which his/her product will be integrated. To do otherwise would risk acquisition of a useless device. In this approach, the product managers are responsible for the HTI and VTI products and the system managers are responsible for the systems including the integration of the several products.

Perhaps no point needs emphasis more than the criticality of product/system interface controls. It is too glib to suggest that the challenge is no greater than occurs routinely in the acquisition of all major systems. Here, a particular HTI product is to be applied to a number of major systems each of which has a high degree of fixity and with constraints that differ from system-to-system. The product manager and the several system managers must find the best solution, overall, taking account of the whole of the needs and several sets of constraints. Only able persons will succeed, and some of them may come close to failure.

Another specific point to be made concerns the development, production, and integration of the several pieces of the tactical C2 digitization ensemble. The view here is that the **inter-system** portion of the ensemble, to include all network controls, message formats, and routing should be the responsibility of the System Architect working with the various PMs for communication systems, especially PM, SINCGARS. Responsibility for development and production, as well as integration, of the **intra-vehicular** portion of the C2 Digitization ensemble should be assigned to system prime contractors, who should use specialty subcontractors as needed. Policies such as ones calling for open architecture, use of Ada, use of commercial microprocessors, etc. can help some but they will not prevent differences in intra-vehicle components amongst the several system primes. On balance, these differences seem less objectionable than any forced fit to components and architecture for systems which, after all, were built to meet different needs and are different. With all these thoughts in mind, and others, the acquisition implications seem to be close to that shown in the table below.

Conclusions.

Close Combat Heavy systems are clear candidates for capability upgrades by horizontal technology insertions. These CCH systems were produced at enormous outlays. They will remain in the field for many years, perhaps decades. As the principal items of what will continue to be more than half the Army, they should be kept state-of-the-art. They have weaknesses that are amenable to correction by HTI and VTI.

Large opportunities are present to upgrade Close Combat Heavy systems' abilities to perform the functions of intelligence and control and the counter-fire function of survivability. Smaller opportunities are present to upgrade the systems' abilities to perform the functions of movement, firepower, and support. Scout vehicles, infantry vehicles, tanks, artillery forward observer vehicles, C2V, and engineer vehicles all can be upgraded. The cost will be large but only a fraction of that of new systems. The outlays would have to be, and can be, spread over multiple years to fit within funding constraints.

ACQUISITION IMPLICATIONS OF CCH HTI AND TI OPPORTUNITIES										
	PROCURE PACKAGE	TYPE PRO-GRAM	HTI/TI PRODUCT DEV/PRODUCER	PRODUCT-SYST INTEGRATOR	RDTE COSTS $M	UNIT COSTS $K	NUMBER RQD (FPI)	PRODUCTION COSTS $M	INTEGRATION COSTS $M	TOTAL INVEST $M
IFF	NEARTERM (P)	IV	GOVT	VEH SYST	2	2	8000	16	20	38
	MIDTERM (I)	III	RADAR SPEC	PRIMES	15	25	5500	137.5	15	167.5
	MIDTERM (T)	III	SAME AS ABOVE	VEH SYST PRIMES	15	25	8000	200	20	235
LOCATION	POS/NAV	IV	GPS SPEC	VEH SYST	3	6	7200	43.2	20	66.2
	HEADING REF	IV	GYRO SPEC	PRIMES	3	4	7200	28.8	20	51.8
TGT ACQUISITION	2ND GEN FLIR	III	EO SPEC	VEH SYS PRIMES VEH SYS PRIMES	30	75	5600	420	15	465
C2 DIGITIZATION	INTER-SYSTEM COM	III	CUR+COM SPEC	VEH SYS PRIMES				0		0
	RADIO INTERFACE	III	??????		2	35	8000	280	20	302
	BUSSES &/OR HDWIRE	III	VEH SYS PRIMES		5	15	8000	120	20	145
	PROCESSOR/MEM/IO	III	VEH SYS PRIMES	ARCH/COM SPEC	5	85	6600	561	15	581
	VEH CONTROLS	III	VEH SYS PRIMES	??????	5	10	2000	20	15	40
	PROGS/DIAGNOSTICS	III	VEH SYS PRIMES	VEH SYS PRIME VEH SYS PRIME	5	5	4500	22.5	5	32.5
SURVIVAB.SUITE	LASER WARNING	IV	EO SPEC	VEH SYS PRIME	0	40	7500	300	20	320
	IR FALSE ALARM	IV	EO SPEC	VEH SYS PRIME	0	10	7500	75	20	95
	M.S. SMOKE	IV	CHEM SPEC		0	15	7500	112.5	20	132.5
	OTHER DEVICES	I	VARIOUS	VEH SYS PRIME VEH SYS PRIME	30	NA	0	0	0	30
BRILLIANT MUNS.	STAFF OR XROD	III	CUR CONT'S	VEH SYS PRIME	200	20	16000	320	5	525
	STINGER SKR	III	EO SPEC	NOT APPLICABLE	200	40	2000	80	0	280
	SADARM	III	CUR CONT		50	20	10000	200	5	255
	SMART MORTAR	IV	FOREIGN	VEH SYS PRIME VEH SYS PRIME VEH SYS PRIME VEH SYS PRIME	0	20	4000	80	5	85
TANK COMP.	AIPS	I	CUR CONT'S	TEST BED CONT	15	NA	0	0	0	15
	ATACS	I	WVLT ARS	TEST BED CONT	10	NA	0	0	0	10
	SUSPENSION	I	CUR CONT	TEST BED CONT	5	NA	0	0	0	5
BFV COMP.	RANGE FINDER	IV	EO SPEC	VEH SYS PRIME	6	12	2600	31.2	25	62.2
	FIRE CONT.	III	FIRE CONT SPEC	VEH SYS PRIME	10	50	2600	130	25	165
					616			3177.7	310	4103.7

COMMAND, CONTROL, AND COMMUNICATIONS.

Progress in this very difficult area has been, and will continue to be, burdened with physical, intellectual and fiscal constraints, and by the fragmented approach which has characterized the past effort. In line with the charter of this study, the following construct attempts to define the constraints, identify some fundamental goals, and outlines some radical/innovative acquisition approaches.

Enduring Limitations:

- The limited frequency spectrum and the austere fiscal environment make it unlikely that there will be any major increase in communication capacity for the tactical forces in this century. The movement of tactical data via EPLRS or some modification of SINCGARS will have to be addressed.

- The focus on protecting the force by providing robust firepower to the Early Entry Force puts a premium on minimizing:

  - The quantity of C2 hardware, shelters and support equipment, such as generators which must be deployed.
  - The need for troops to man C2 terminals.

- The desire to provide NRT imagery in every commanders will be restricted by the available radio spectrum.

Given these constraints it may be appropriate to relook the entire C3I area and identify those capabilities and approaches which have the greatest payoff and likelihood of success.

- At the operational levels of corps to Brigade the Army is developing the ATCCS system. ATCCS is composed of five separate functional systems, with a superset of the information produced, dubbed IFLCS, resident on the maneuver Control System. The CSS element of ATCCS includes many

individual software systems known as STAMISs, each of which was individually developed to support a particular support function, ie personnel, pay and allowances, ...

- The armor center is evaluating the IVIS system to interconnect the ground combat elements, with initial implementation on the M1A2 tank and one M2. The aviation community is experimenting with a second generation target hand-off system which interfaces with the fire control via TACFIRE.

Ongoing Technology Insertion:

Although the terminology Horizontal Technology Insertion is new, the Army has in fact been practicing HTI for years. Based on the growing cost of the tactical automation programs, the DA directed the acquisition community to define, procure and adopt a common set of COTS automation hardware (and operating systems) in the mid 80s. Based on this guidance, the CHS I equipment was placed under contract in 87-88? and has provided the foundation for the development of ATCCS, less the ASAS which remained on unique DEC hardware and the DEC operating environment.

In the communications area the ATCCS has planned to move all data over the combination of EPLRS, SINCGARS and MSE. The MSE and SINCGARS radios were defined and supported primarily as voice communications systems, with EPLRS providing a data only capability. As of today, the future of EPLRS is in serious question, with any buy so limited that it will probably cause more problems than it solves. The SINCGARS has a very limited ability to pass digital information and has no inherent provision to forward data from one net to another. The MSE is being equipped with a packet switching capability which will improve its data capabilities, but the system being implemented is not totally compatible with the DOD standards as implemented in DDN. Because of concerns with the capacity of these systems, the ASAS program office has pursued its own unique UHF data link to connect the forward ground sensors into the ASAS. Finally, none of these radio systems has the ability to pass digital data from one radio type to another. This is not a seamless network!

Current Status: The many Army C3I programs have consumed a significant portion of the R&D budget for the past decade with annual expenditures in the hundreds of millions of dollars. In addition, six to seven billion have been invested in modern radios, with the procurement of the MSE system and the initial fielding of SINCGARS. The most evident results of this $10 billion plus program are a robust voice and growing data capability at echelons corps thru brigade provided by MSE and an improved voice capability for tactical users who have received SINCGARS. The anticipated tactical battlefield automation is still an unfulfilled promise, with the exceptions of the user developed UTACCS and KOREA CCS.

Focus On The Fundamental Reasons For Automating C3I. Of the many volumes published on Army C3I it is very difficult to identify the underlying goals of the C3I system and how the many components contribute to meeting these goals. Consider the following simple construct for a minimal, but useful C3I capability:

- Gather data and move it into the C3 system with minimal operator interaction.

  - Automate interfaces into sensor systems
  - Provide simple, user friendly tools to input force status information.

- Move the data from its source to user who need it without operator intervention

- i.e. a seamless environment, with automatic routing.

- Organize, process and store the information to support commanders and staff elements with minimal "clerical support."

- Display data for decision/action - provide a synopsis of the commanders guidance, identify the target for attack, and the weapon(s) which is capable of destroying that target.

- Provide the reliable means for the commander to direct his forces and for the staff to monitor the progress of the execution.

Over the past few years, the information management community has evolved a technology to identify a coherent set of requirements to support a given operation. This technique known today as Business re-engineering provides a structured approach to defining the process to be automated and provides a relatively simple, non-threatening environment in which the technologist and the operator can define their mutual needs. The application of this capability to the ACCS could achieve three goals:

- Provide an automation plan which the operator can approve with reasonable confidences that he understands what he is getting.

- Minimize possible redundancy among the BFA systems. For example, what is the proper relationship between artillery ammunition inventory in the AFATDS and the CSS system? What data resides where?

- Identify gaps in desired information flow between systems.

Finally in light of the very stringent constraints it would seem appropriate to identify those functions which:

- Can provide a major improvement in the ability of the force to fight, ie a baseline set of functions.

- Are "nice to have" and can be deferred until the user has experience with the baseline.

- Are in the "Too hard" category, for example:

  - An MLS capability across the entire ACCS - this technology will eventually be developed by users with much greater needs and budgets than the Army.

  - Near real time imagery to tactical battlefield commanders. The limited communications capacity can be better employed to support the sharing of a common picture of the battlefield and a local situational awareness.

This "parsing" of the users wish list, coupled with a complete business re-engineering analysis could result in the definition of a simpler, understandable C3I system which is supportable with available commercial technology.

Potential Technology Insertions:

- CHS II with fully open characteristics - no proprietary software.

- A true common set of support software - i.e. CASS.

- Data oriented file transfer.

- A common data element dictionary for all ACCS, which hopefully is compatible with OSD and other service standards.

Innovative Acquisition Approaches:

It occurs to me that there are probably three potential courses of action to build the ACCS:

1) Business as usual. Continue almost business-as-usual with increased emphasis on making the system open, seamless, etc. Not clear how this will converge to the desired solution in our lifetime. An interim approach to support this process might include - implementing gateways

which rely on DIS common standards as the "neutral" medium to form bridges between the families of systems.

2) Suspend current contract activities for one year and define where ACCS is going. This approach would essentially suspend all the ongoing automation contracts, and negotiate with the vendors to employ their people in a one year focused effort to define the totality of the ACCS. As an incentive to complete the following actions, the contracts would be canceled after the year unless the following actions were completed:

- Individuals from each vendor, PM, and TSM shop who work data would be locked into the data standardization room.

- The TSM, other user representatives, and the system architects would be locked in a business re-engineering room for each major subsystem, MCS, ASAS,.etc. After two months, all the components of the ATCCS elements would move to the ATCCS re-engineering room to harmonize the subsystems into the overall ATCCS. Finally, all elements of the ACCS would be moved into the ACCS room "until they got it right."

- All proponents of CASS would be locked into the CASS room, complete with work stations which could support software evaluation. This group would not see the light of day until a "common CASS" was agreed.

- The system engineers would form the CHS II+ group and would evaluate the candidate systems, including running their existing applications code before a source is selected.

- All communications engineers, signal types, data parsers, etc. would be locked in a seamless room until they figured out how to tie the multiple communications elements and their supported automation into a smart data exchange system.

- These last three groups, CASS, CHS II+ and communications would move into a laboratory environment for months six through nine to establish The ACCS Development Environment (TADE) with all the elements integrated and documented to the satisfaction of the group.

The graduation exercise would include:

- Existing applications [illegible] be brought into the lab and ported into TADE to demonstrate to both the operating [illegible] group and the applications software group that a common environment had be[illegible]

- The business re-enginee[illegible] p would meet with the the applications software group to:

  -- Evaluate the utility of existing applications code
  -- Identify the code which would not be pursued
  -- Agree on the requirement for the the missing code and the order of development

- And finally the Data element group would present their data set to the business reengineering group and the applications software group for suitability and completeness.

At the end of the year, the community would be in the position to renegotiate each of the contracts, based on the requirements defined by the process. With the added advantage that both the government users and developers will share a common perception of the problem with the vendors. If the Army could see their way clear to suspend the current contract effort and clear the many hurdles with the vendors, this approach would move the ACCS from a realm of probably fifty different contracts/vectors to a common basis of design and implementation which is much more likely to succeed and which by virtue of its "cleaner Requirements" is likely to be much more affordable.

3) The third option would be to cease all work on all ACCS components, form a set of teams as above, define the "new seamless ACCS", and then begin the contracting process all over again. This approach would take two to three years out of the program and probably result in many protests. It is too radical to consider.

Notes on C3I Background.

The current Army C3I program is composed of a multitude of individual systems.The model for interoperability among these systems derives from the JINTACCS family of character oriented massage formats. These messages were structured for human intreperation in teletype format and do not represent a rational approach to machine to machine data transfer. The elements of the current Army C3I program, shown in figure 2.2.4-1, include:

- Until recently, the Army did not have plans for an automation system to support the Army commander. Based on experience with the USAEUR developed UTACCS, the Army has established a requirement for a C2 system to support commands at EAC. The STACCS will support the Army commanders, but its role vice the AWIS is currently under review.

ENGINEER AND MINE WARFARE.

The Corps of Engineers (COE) has a broad support mission. That mission is to provide combat engineering to our forces as they move through the battlefield while at the same time degrading the enemy's mobility and target acquisition capability. The Army has a wide range of equipment and requirements for their combat engineers. Unfortunately the Engineers have lagged behind the hardware modernization that has occurred in the Army's other elements of the maneuver force.

Engineer functions include the mission areas of:

Mobility	Countermobility	Survivability
Sustainment Engineering	Topographic Engineering.	

Mobility.

Mobility missions for engineers include those actions which enable a force to move troops and equipment about the battlefield without delays. Impediments to force mobility include terrain, weather, and both natural and man-made obstacles. As part of Combined Army Operations, engineer units enhance force mobility by executing operations in clearing mines or breaching minefields and other obstacles, crossing gaps, building or improving roads, trails, and supporting aviation-forward.

Mobility Assessment.

Countermine/Counter Obstacle (Detection): The detection of obstacles ahead of actual encounter provides information to the maneuver commander in time to bypass or breach the obstacle. In the near to mid-term, the COE has only the AN/PSS-11 and AN/PSS-12 Mine Detectors which detect only metallic components of mines. The vehicle mounted mine roller is not effective for detecting double impulse, magnetic fused or standoff mines. In the far-term, the Aerial Stand Off Minefield Detection System (ASTAMIDS) will be fielded in limited numbers (budget constraints). Planned advanced technology demonstrations include the Close-in Man portable Mine Detector and Vehicular Mounted Mine Detector.

Countermine/Counter Obstacle (Breaching): Current technology is limited to the Bangalore Torpedo (for dismounted breaching), the Mine Clearing Line Charge (MICLIC), the M1-mounted Battalion Countermine Set (BCS), and limited quantities of the M728 Combat Engineer Vehicle (CEV)-mounted full width mine rake. Fielding the Small Projected Line Charge (SAPLIC) and the Anti-Personnel Obstacle Breaching System (APOBS) could raise the rating of dismounted breaching. Fielding the Standoff Minefield Breacher (SMB), Off Route Smart Mine Clearance (ORSMC) System

for side attack and wide area mines, and the Combat Mobility Vehicle (CMV) Armored System Modernization (ASM) variant in sufficient quantities are required to improve breaching capabilities. Teleoperation or robotic breaching will be needed in the future.

Counter Mine/Counter Obstacle (Clearing): Non-metallic mines are difficult to detect. Today, the COE can only clear individual mines with hand placed demolition charges or the D7G bulldozer equipped with the Mine Clearing/Armor Protection (MCAP) kit, although the latter has limited capability and is in short supply.

Gap Crossing (Assault): Gaps encountered in the assault must be quickly crossed; gaps are usually covered by fire, and assaults are typically met with fire. The assault bridge must have survivability and mobility characteristics similar to supported forces. The ALVB is Military Load Classic (MLC) 60 and cannot support the Abrams tank fleet except under "caution" conditions. Mounted on the M48/M60 chassis, the ALVB lacks mobility, survivability, and logistics compatibility with the supported forces. The ALVBs are worn and nearing the end of their operational lives. While 183 improved ALVB systems, upgraded to carry MLC 70, are scheduled for production, they do not overcome the above problems. The newer Heavy Assault Bridge (HAB) provides gap crossing capability for the Abrams fleet, but it will be fielded only in the mid-term, and only in limited numbers. The current heavy assault float bridge capability is the truck mounted Ribbon Bridge (RB). The RB is vulnerable to small arms fire and lacks the mobility of tracked systems. The unfunded Improved Ribbon Bridge (IRB) increases survivability of the bays, but provides no operator protection. Both bridges require considerable time to erect and are held in place during the crossing by very vulnerable bridge erection boats with exposed crews. No heavy assault float bridging capability is projected to provide mobility and survivability comparable to the supported forces.

Gap Crossing (Follow-on Bridging): Follow-on bridging replaces assault gap crossers as time and assets permit. Wet gap assets (wet gap bridges float on the waters surface) include the Light Tactical Raft (LTR), Aluminum Floating Foot Bridge, and the M4T6 Floating Bridge -- all 1950s era bridges. The Ribbon Bridge lacks survivability. Only the unfunded IRB program addresses this deficiency. Current dry gap assets (dry gap bridges span the gap or are supported on piers above the water surface) are the M4T6 Dry Span Bridge, the Medium Girder Bridge (MGB), and the Bailey Bridge. These bridges are too narrow, too slow to construct, and require our troops to be exposed when they carry multiple, heavy bridge sections and assemble these bridges. The Heavy Dry Support Bridge (HDSB) addresses these deficiencies, but it is scheduled for procurement only in limited quantities.

Countermobility.

The engineers are also responsible for helping deny battlefield mobility to the enemy. Engineer counter operations include all tasks designed to negate, impede or disrupt threat force movements in order to assist our forces to achieve their objectives. Natural and man-made obstacles can be delivered and covered by observation and friendly fire. Scatterable mines and minefields can be delivered by a variety of means. Target-seeking wide-area mines can be employed literally "on-top-of" enemy formations. The use of dynamic obstacles is an effective way to neutralize or kill opposing combat forces.

Countermobility Assessment.

Mine Warfare (Scatterable Mines): Scatterable Mines offer maneuver commanders the capability to place "dynamic obstacles" (Scatterable mines and mine fields deliverable by a variety of means and "target-seeking" wide-area mines) on top of enemy formations. When combined with Anti-Helicopter Mines, Dual Sensing Fuses, a universal remote control system, and "intelligent minefields" that function as autonomous obstacles, this technology characterizes the future of mine warfare. A limited number of Modular Pack Mine System (MOPMS), VOLCANO, and GEMMS mines, and GEMMS and FLIPPER dispensers will be available in the near future. Deficiencies in this area include lack of VOLCANO reloads, a side attack mine capability, sophisticated fuses, wide-area mines, anti-helicopter mines, helicopter mounted mine dispensers, and mine deep delivery systems. The GEMSS mine dispenser will not be survivable in an NBC environment and is maintenance intensive. It will be withdrawn in FY94 as it is replaced by ground VOLCANO. There are too few dispensers and mines

to meet mission needs of a fast moving battlefield. Additionally, host vehicles for the VOLCANO system may be over tasked and not be readily available to carry out the VOLCANO delivery mission, therefore requiring VOLCANO to be adapted to other host vehicle types (i.e. HMMWV and the Bradley Fighting Vehicle). While the VOLCANO-delivered Wide Area Mine (VOLCANO-WAM) is scheduled for introduction in the mid term, its introduction alone cannot raise the rating. More counter measure resistant Multi Sensor Electronic Package (MSEP) fuses will be fielded in FY96. All systems fielded during this period feature BNC survivability. Sufficient quantities of Wide Area Mines (WAM), anti-helicopter mines, dual-sensing fuses, a universal remote control system for mines and demolitions, and "intelligent obstacles" will result in a far term improvement. The Intelligent Mine Field (IMF) ATD will demonstrate extended range overwatch sensors and communications to execute coordinated tactics to multiple smart and conventional mine performance.

Mine Warfare (Conventional): A requirement remains for conventional mines and minefields which do not self destruct and can remain in place for long periods of time. Much of the large inventory of conventional antitank and antipersonnel mines dates from the Korean War and they are deteriorating with age. While sufficient quantities exist to meet mission requirements these mines are primarily located in USAREUR and the United States, not in expected future contingency areas, and are not easily transportable. An assortment of fuses and anti-handling devices are required. To improve transportability it will be become necessary to adapt existing lightweight mines such as the hand emplaced Selectable Lightweight Attack Munition (SLAM) being developed for Special Operations Forces to render a longer than 24 hours active life. It's selectable modes and self-neutralization capability make it a suitable candidate for mid-term modernization of conventional mine warfare. The mines are metal based, thus easy to detect, and they are time, manpower and logistically intensive to emplace. NBC environments do not degrade their performance. Improved fuses capable of full-width attack, possessing higher countermeasures resistance, and reducing density requirements will be fielded in the mid-term in limited quantities. The introduction of Improved Conventional Mine (ICOM) will be a far-term improvement.

Obstacle Development (Explosive Obstacles): We have no explosive antitank ditch capability. A limited capability exists for bridge demolition, using time and labor intensive WWII techniques which expose troops to small arms and artillery fire. The Bridge and Road Munition (BRM), or some alternative concept such as the multipurpose Standoff Penetrator, could alleviate this shortfall, but only limited quantities may be available. There is no effective tunnel demolition technique. Initiation systems are also deficient. The M180 Cratering Demolition Kit is unreliable and hazardous to use. The WWII vintage 40-lb shaped charge, used to create a hole through pavement for emplacement of a 40 lb cratering charge, is often ineffective, particularly against high quality pavements. It is bulky and time and labor intensive to deploy; it impedes last minute movement by friendly forces; and it must be "tailored" in emplacement design for various pavements and roadbeds. Booby traps are positioned to increase the effectiveness of other obstacles and prevent enemy soldiers from rendering mine, wire, and/or other obstacles ineffective. They can include anti-handling devices, pungi pits, and daisy chain minefields, etc. Currently fielded M1, M1A1, M3, M5, M142 and M49A1 firing devices and trip flare initiation devices are compatible with existing munitions, but are susceptible to infrared and microwave detection. The blasting cap/detonation cord/explosive block system currently used for expedient obstacles is time and resource intensive. The Penetration Augmented Munition (PAM) will be used in the midterm to demolish dams and tunnels, and to make expedient obstacles, but we lack a portable explosive for destroying structures. New explosive devices such as PAM, the Time Delay Firing Device (TDFD), and the Selectable Lightweight Attack Munition (SLAM) are being developed by Special Operations Command and could contribute to our ability to have light weight, powerful explosives available to create expedient obstacles. The Modernized Demolition Initiator (MDI), due for fielding in FY95, is an easy-to-use EMP/RFI-proof initiator which will be available only in limited numbers.

Obstacle Development (Nonexplosive obstacles): Log cribs, tetrahedrons, hedgehogs, falling blocks, log obstacles, and abates are nonexplosive obstacles. Steel beams, concertina wire, and concrete tumble blocks can be obstacles. Antitank ditches are dug using engineer equipment and are effective against vehicles, and sometimes when flooded and mined against foot soldiers. Disabled vehicles can

be used to deny airfields or roadways. These obstacles reinforce existing terrain and compel opposing forces to prematurely expend mobility assets.

Wire is used as an antipersonnel obstacle. Antitank ditches, dug with the ACE, D-7 bulldozer and bucket loaders, require favorable soil conditions and extensive preparation time. While material is usually available, units operating in sparsely forested regions require additional logistical resources.

Survivability.

The engineers enhance battlefield survivability by constructing fighting positions, protective shelters, and field fortifications; by terrain selection; tactics; camouflage techniques; and deception operations. Engineers also provide both manpower and equipment for decontamination of terrain, equipment, and troops.

Survivability Assessment.

Camouflage and Concealment: Visual observation is only one of many currently available battlefield sensors. Modern sensor systems can detect man-made objects and terrain disturbances that are concealed from, or unseen by, the naked eye. Currently, our vehicles and equipment have patterned camouflage paint schemes, and standard ground anchored net systems, but neither of these camouflage means are effective when vehicles move. The Soldier Integrated Protective Ensemble (SIPE) will be introduced in the mid-term, but may not provide adequate reduction of thermal signature. Also in the mid-term, we envision increasing sophistication in third world nations and the emergence of newer sensors which use greater portions of the electro-magnetic spectrum. The addition of the Multi-Spectral Camouflage System (MSCS), fielded in the far term, and the continued use of the camouflage systems and netting mentioned above will improve the capability. Current packaging materials are not camouflaged and while nets and canvas tarps provide some protection, they do not conceal field supply points, most of which require large, usually open, areas of terrain. Current screening systems and canvas tarps provide limited camouflage in open areas. Fixed facilities provide concealment, but field loading facilities do not, and the current LCSS cannot screen supply activities due to their size and signature characteristics. Masking terrain remains a problem in all terms. The current LCSS performs minimally in this area, but with the limited stocks available, some unit equipment would go uncamouflaged in order to achieve even a modest capability.

Deception: This consists of the physical deception actions taken at unit levels by engineers and others. Such actions include additional excavations to replicate fighting positions, construct decoys, and emplace phony minefields and barriers. These are normally performed by on-hand personnel and equipment; additional manpower and equipment to undertake these actions are typically unavailable.

Protection: Physical protection to individuals from indirect fire fragments, direct fire projectiles, and from observation by RISTA sensors will continue to be top a priority. Modern mines, accurate long range indirect fires, improved conventional munitions, and the proliferation of aircraft and armored vehicles constitute a severe challenge to the individual soldier. The Soldier Integrated Protection Ensemble (SIPE) will offset some increased threat capability; SIPE protects soldiers from environmental conditions, but provides little ballistic protection. Other measures such as overhead cover, shelters, and revetments also affect individual soldier protection. The COE has only a limited capability to construct protective positions or cover materials. While both the Ballistic Protective System (BPS) and the HSE will enhance the survivability of supplies and equipment, the increased lethality, sophistication, and proliferation of threat target acquisition and munitions delivery systems will increasingly disrupt our resupply and repair actions. The lethality of missile, rocket, long range cannon, and aerial delivered munitions is expected to continue to increase. As it does, our ability to provide adequate protection will be outpaced.

Fortifications: Various types of field fortifications will continue to be needed on the battlefield. There are too few excavation assets to dig required positions. Mechanical excavators are slow and not available in quantities to support our maneuver forces. Excavators, other than the ACE, are not survivable when operated in forward combat areas. Conventional explosives are available, but as

lethality increases, the inefficiencies of our current explosive excavation techniques likewise increase. An explosive type device to dig foxholes and larger excavations is also needed. There is currently no material solution to the present day lack of ballistic overhead cover (other than natural material -- timber and soil) or heavy, bulky Class IV construction materials. The limited amount of Class IV materials means that we cannot adequately protect the fighting positions of our troops. Further, the lack of proper position construction in training and not enough excavators in forward units, directly links unit vulnerability to heavy fires.

Decontamination Support: Engineers will be called upon to conduct route and area decontamination and clearing, and to conduct hazardous waste removal and disposal.

Excavation Support: Current engineer equipment does not provide operator/crew protection when clearing hazardous materials. Other than scrapers, the equipment tends to spread contaminants. In the mid and far terms, hazardous materials may become more prevalent and thus place greater burdens on existing equipment. The Army does not practice combat condition hazardous waste disposal; nor is it equipped to conduct such operations.

Sustainment.

Sustainment engineering tasks are performed as part of rear operations and provide the capability for logistics throughput to all echelons of battle. These engineering tasks consist of construction of various facilities and rehabilitation of roads, airfields, buildings, terminals, and ports. Special purpose tasks include fire fighting, pipelines, deep water diving, bridges (construction and repair), engineering materials, well drilling, and electric power production and distribution.

Sustainment and Engineering Assessment.

Sustainment engineering includes those tasks which support forces by maintaining, upgrading, repairing or constructing lines of communication and facilities, providing construction support and materials, and performing area damage control. Typical infrastructure includes ports, airfields, roads, pipelines and logistical nodes. Vertical construction requirements include the construction of buildings and other structures, using the skills of carpenters, steelworkers, plumbers and electricians. Horizontal construction requirements include earth moving and paving to construct roads, airfields, and similar infrastructure.

Topographic.

Topographic engineers provide knowledge of the battlefield including the impact of terrain and weather on operations.

Topographic Engineering Assessment.

Commanders require continuous information about terrain and environmental changes during both planning and execution phases of combat operations. Such data is critical to the command and control process and equally important for weapons systems which need such data for successful deployment and operation. The objective is to give our forces timely information about the terrain and the battlefield environment, and to understand the impacts of this information on combat operations. Our command and control, and many of our weapons systems depend on this information.

Data Base Support.

Data base support incorporates the elements of data collection, creation, updates, and management. Topographic engineers are transitioning from paper products to digital based systems. Still, current TO&E's support paper based products. The COE is acquiring a limited capability, however, to access national and commercial data systems for exploitation. Their importance was clearly evident during Operations Desert Shield and Desert Storm, and that ensures continued development of these systems. Commercial off-the-shelf equipment will be purchased, and command and control links must be

established to fully use the data. We cannot at present collect and manage information to respond to contingency missions in a timely fashion or create digital terrain data bases. We have only a limited ability to exploit imagery for map and map substitute production. Standard digital topographic data bases are not available worldwide, and no automated assets for field collection efforts exist to provide terrain information updates. The fielding of the Digital Topographic Support System (DTSS) provides the initial capability to transition and tactically exploit digital topographic databases. These are required in all contingency areas to fully exploit the DTSS potential. Preplanned product improvements to DTSS, to include the local creation of topographic databases, from multiple sources (including imagery) must be funded. Increased availability of digital topographic databases maintained on a consolidated digital topographic data manager may occur in the far term, contingent upon the approval of the Digital Cartographic Capability (DCC). There are currently limited capabilities to establish precise survey control to denied areas. TOE automation to help process survey data and reduce time between the collection and the processing of survey data is required.

Topographic Products.

A requirement exists to rapidly produce special topographic products tailored to areas, conditions, and operations. Such products, often tactical decision aids, assist commander and soldier alike to command, control, and execute missions and include traditional maps, electronic map substitutes, and electronic enhancements to determine positioning information. Division, corps, and EAC topographic units require a mobile capacity to provide rapid low-volume reproduction of color overprints, terrain graphics, and other topographic products. Field reproduction technology is old and inefficient, especially for low-volume, special products reproduction. We need the capability to produce updated and enhanced digital topographic data bases and the field capability to reproduce special products from digital data. Midterm upgrades are planned to the Topographic Support System (TSS). The Quick Response Multicolored Printer (QRMP) will be fielded in the midterm, thus resolving the low rate, special product reproduction problem. Replacing current press systems at theater levels, possibly with an upgraded/next generation QRMP, would improve response time and reduce operation and support costs. Introduction of the Automated Integrated Survey Instrument (AISI) and the Army precise Global Positioning System (GPS) increase survey capability in the far-term.

Distribution.

Improvements in the communication links needed to pass large volumes of mapping data are currently in the research stage and are not expected to be fielded until sometime in the future. Terrain analysis products and updates are difficult to pass to units dispersed across the battlefield. The COE needs automated interfaces between DCC and ASAS/MCS, terrain evaluation software for maneuver units, initiation of graphic interchange standards, and improved communications media. The Survey Information Center (SIC) is also needed to coordinate local changes and enhancements of survey data into topographic databases.

Engineer Systems Status (RDA).

Construction Equipment: Per VCSA approval, engineer FM funding for construction equipment will be raised to a consistent $25 million per year beginning NLT '96 POM. This will provide 3:1 operations and support cost avoidance. ($118M)

Digital Topographic Support System/Quick Reaction Multicolored Printer: DTSS will begin fielding in 1994. QRMP will begin fielding in 1996. Twenty-two of each will be fielded to TOPO units which support all FP1 Divisions, all Corps, and all Army CINCS. ($164M)

VOLCANO: Multiple Mine Delivery System, already fielding truck mounted systems. M548 systems begin fielding in August '93 (24th ID). Korea and USAREUR in April '94, and August '94, respectively. Air VOLCANO being procured this year, expected to begin fielding in FY'95. On going ammunition procurement is approaching 1 million anti-tank mines. ($52M)

DEUCE: RDTE in '94 President's budget. Procurement dollars planned for '95 and '96 - enough to field 45 vehicles to light divisions, separate light brigades, 2 ACR, and training base. ($16M)

WAM: Wide Area Mine, procurement of hand emplaced variant to begin in FY '96. VOLCANO emplaced and deep attack variants in RDTE for later procurement. Considered a "silver bullet" by Army leadership. ($180M)

Improved Ribbon Bridge Transporter: A HEMTT variant to transport the 6-ton ribbon bridge loads. Procurement begins in FY '96. Plan to buy five companies worth, remaining companies will use newest 900 series truck. ($46M)

Heavy Assault Bridge: (HAB) Procurement planned for FY '96. Current procurement objective is 106 -- recognized by Army leadership that this is not enough, may grow to 350. ($226M)

BREACHER: Procurement planned for FY '97. As Heavy Assault Bridge (HAB), procurement objective is 106 -- should be increased possibly to 340. ($459M)

Aerial Standoff Minefield Detection System: (ASTA MIDS) UAV mounted detector to be procured beginning in FY '99. ($120M)

The systems considered are those mentioned in Annex A of the Army Modernization Plan. they, together with the results of the first winnowing, are shown in the Table below. A strike through line indicates that the system was set aside not as a candidate for technology insertion. The rational for the set aside, keyed to the criteria in the Table on Page 2 are also shown.

Engineer and Mine Warfare Systems Considered			
~~AN/PSS 11/12~~	[8]	RB/IRB	[6]
ASTAMIDS	[7]	~~LTR/M476~~	[5]
~~MICLIC~~	[8]	EDSB	[6]
~~BCS~~	[8]	~~MOPMS~~	[4]
~~M728 CEV~~	[4]	~~VOLCANO~~	[4]
~~SAPLIC~~	[4]	~~GEMMS~~	[4]
~~APOBS~~	[4]	IMP	[6]
SMB	[6]	SLAM	[6]
~~ORSMC~~	[4]	~~DTSS~~	[8]
~~MCAP~~	[4]	~~DEUCE~~	[8]
~~ALVB~~	[5]	WAM	[7]
HAB	[6]	BREACHER	[7]

The Table below arrays the identified technologies vs. systems for which their application is assessed to be appropriate.

ENGINEER AND MINE WARFARE HORIZONTAL AND VERTICAL TECHNOLOGY OPTIONS									
SYSTEM	NBR SYS RQD	HORIZONTAL TECHNOLOGY INTEGRATION							VERTICAL SYSTEM TECHNOLOGY INSERTION
		BSIC	SECOND GEN FLIR	POS/NAV SYSTEM	COMMAND CONTROL DIGIT.	SURV ENSEMBLE VIDS	BRILLIANT MUNITIONS		
ASTAMIDS	FUTURE						***	FY '99
SMB	NOT PROD							DEM VAL TO '96
HAB	340			***		***		ABRAMS CHASSIS
RB/IRB	FUTURE							UNFUNDED/VULNER
HDSB								LIMITED QTY NOW
IMF	FUTURE						***	TECH DEMO
SLAM	SOF						***	
WAM							***	FY'96 PROD
BREACHER	340							PLANNED FY'97
DTSS	22 OF EA							FY'94
SAPUC								PROD IN '94
VOLCANO								PROD THRU '98

Summary.

The wide range of missions for the Army COE requires a tremendous array of weapons systems and equipment. The preceding section provides an overview as to what is perceived to be important (funded) by the Army leadership. The exciting opportunities in this area are in the advances to mine warfare that can be made with the advent of a coordinated, digitized modern battlefield. The ability to easily emplace and activate, deactivate and remotely monitor mines adds a whole new dimension to ground warfare.

In the modern concept of remotely managed and monitored minefield obstacles, it will also be important to tie-in to safeguards to protect friendly forces. Fail-safe mechanisms and even Combat Identification concepts should be incorporated consistent with integration into weapons systems.

AIR DEFENSE.

Army Air Defense Artillery (ADA)

ADA is looking toward modernizing to meet the threat tposed by current and future aerial weapons systems to U.S. Forces and key national assets throughout the world. The AD concept has segmented the battlefield into five (5) areas of concern. These areas are defined below.

Strategic Air Defense (AD): Strategic air defense requirements focus on the need to protect the US (CONUS, Alaska, and Hawaii) against accidental, unauthorized, or limited ballistic missile attacks and the use of enemy satellites by engaging these targets with ground based air defenses. Strategic air defense is the Army's contribution to the strategic manned aircraft, air-to-surface missiles, and low-earth-orbit satellites.

Theater Strategic Air Defense (TSAD): Theater strategic air defense requirements are driven by the theater Commander-In-Chief/National Command Authority (CINC/NCA) and include the protection of Theater Strategic assets, those non-military elements within a theater of war deemed critical to success of the overall theater campaign. These include geo-political targets such as national capitals, critical industrial areas, or major population centers.

Theater Area Air Defense (TAAD): Theater Area Air Defense requirements are determined by the theater commander's need to protect the force throughout the theater of operations - that portion of an area of conflict or war necessary for military operations. This includes high value theater assets

necessary for military operations (i.e., C3 Facilities, Aerial Ports of Debarkation (APODs), and Sea Ports of Debarkation (SPODs)). ADA Theater Missile Defense (TMD) elements protect all theater assets from attack by enemy missiles.

Corps Area Air Defense (CAAD): Corps ADA Brigade elements protect critical forces of the corps in support of the maneuver force committed to close battle in the corps area.

Forward Area Air Defense (FAAD): Forward area air defense operations are driven by the maneuver force operational requirements, particularly within the close battle area, by denying threat aerial reconnaissance and defending against a wide variety of hostile aerial vehicles, to include attack helicopters, UAV's, and close air support fixed wing aircraft.

The US Army Modernization Plan, Annex E, Air Defense, further breaks down AD into a series of base cases; Near-Term (Fiscal Year 1994 & 1995), Mid-Term (Fiscal Year 1996 to 1999), and Far-Term (Fiscal Year 2000 to 2008). Current and proposed systems are described below:

STINGER: STINGER provides defense against attack by low flying fixed wing and selected rotary wing aircraft. STINGER is the primary air defense weapon on the AVENGER and selected rotary wing aircraft. It is used in the Man Portable Air Defense System (MANPADS), shoulder fired role by MANPAD teams carried in HMMWVs and in BSFVs. A fire and forget system, STINGER uses passive infrared homing guidance. The system is comprised of the weapon (missile in launcher and reusable gripstock), and Identification Friend or Foe (IFF) unit, trainers, and ancillary equipment. STINGER modernization is achieved via software changes which enhance its capability to counter the evolutionary countermeasures threat. The STINGER-POST system updated the guidance system countermeasures capability through the use of a dual color (infrared/ultraviolet) seeker. In response to threat IRCM advances, the STINGER-POST design was further upgraded to STINGER-RMP. The guidance and tracking functions of the STINGER RMP are under software control and are reprogrammable via memory module located in the gripstock external to the missile. It has improved performance in ground clutter, night engagements, and reactive countermeasures. The Advanced STINGER incorporates an infrared focal plane array seeker which improves acquisition of targets in clutter.

Bradley STINGER Fighting Vehicle (BSFV): The Bradley STINGER Fighting Vehicle is the Army's interim solution to the Line-of-Sight Forward Heavy (LOS-F-H) requirement and provides MANPAD Stinger missile teams increased mobility and survivability, allowing better air defense support of maneuver forces. Further, Bradley organic armaments provide additional capability in the close-in ground and air defense roles. BSFV is operated by a three-man air defense crew augmented with a two-man MANPADS STINGER team.

AVENGER Line of Sight-Rear (LOS-R): AVENGER Line of Sight-Rear is operated by a two-man crew for stationary shoot-on-the-move defense against fixed wing aircraft and selected rotary wing aircraft at low altitude, day or night, in clear or adverse weather conditions, in the brigade or division rear areas. The system places the highly lethal and capable STINGER missile/.50 caliber machine gun on a platform HMMWV to increase firepower and mobility of the air defense force available to the ground commander. It operates with Basic STINGER, STINGER-POST, or STINGER-RMP missile rounds. AVENGER replaces existing STINGER Man-Portable Air Defense System (MANPADS) teams in divisions, ACRs, and separate brigades. AVENGER is being fielded to corps and theater FAADS battalions and displaces CHAPARRAL batteries. Modernization includes modifications to improve crew efficiency, increase effectiveness, enhance performance, interface with FAAD C2I, and increase mobility.

Combined Arms Initiatives (CAI): Combined Arms Initiatives improve self-defense capabilities against threat aircraft for our combined arms components and augment current and future air defense assets on the battlefield. Communications systems interface with FAAD C3I via the Army Tactical Command and Control System (ATCCS) and combat tactical net radios, thus enabling receipt of air defense data. Modernization includes the integration of the Air-to-Air STINGER (ATAS) system on selected aircraft, fielding of an air defense reticule sight and improved 25mm ammunition on some

Infantry Bradley Fighting Vehicle Systems, and development of a new ammunition, NLOS/CA, for the M1A1 and M1A2 tank to provide engagement of threat helicopters at greater ranges.

PATRIOT: PATRIOT, an extremely capable system, is presently the centerpiece of the Army's CAAD and TAAD forces. The combat element of the system is the firing battery which consists of a multifunction Radar Set (RS), an Engagement Control System (ECS), a power plant, requisite communications, and four to six launchers. The phased array RS performs all tactical functions or airspace surveillance, target detection, and track and missile guidance. The only manned element of the firing battery during the air battle, the ECS, provides human interface for control of automated procedures. Each launcher contains four ready-to-fire missiles, sealed in containers. PATRIOT is deployed as a battalion.

Modernization includes Quick Response Program (QRP) improvements to emplacement and guidance capabilities (a response to the Desert Shield/Storm experience); Radar Enhancements (Phase II) increases in low observable target detection capability; enhanced Weapons Control Computer (WCC) and peripherals to increase computer speed and memory size; Positive Hostile Identification (PHID) features for protection of friendly air; Electric Power Plant (EPP) signature reduction; and, communications improvements.

Elements of PATRIOT BLOCK II include out of sector launch which develops software for the capability to emplace PATRIOT launchers within a 360 degree radius of the radar and additional PHID features to maximize enemy attrition with minimum fratricide. The formidable performance of PATRIOT against air breathing threats (ABT) and its versatile system design, provide a logical point of departure to meet the growing tactical missile threat. PATRIOT PAC-1 software modifications and PAC-2 missiles provide the foundation for the Army's near-term active TMD. PAC-3 is a series of significant cost effective upgrades designed to buy back battlespace lost due to advances in the air breathing threat (ABT) (e.g., cruise missiles) plus extended PATRIOT's anti-tactical missile footprint to protect assets within a larger area.

BLOCK III, Theater Surface-to-Air Missile (TSAM) (intended to replace PATRIOT after the year 2000) becomes our high and medium altitude component of the corps and theater/theater strategic air defense. TSAM has a modular design that integrates the Air Defense Tactical Operations Center (ADTOC) and includes a new missile that engages threat RISTA platforms and standoff fixed wing or heliborne jammers. TSAM provides theater commanders the ability to launch tactical satellites to support short duration corps and theater operations; it will accommodate any additional tactical missile developed by Ballistic Missile Defense Office (BMDO).

Extended Range Intercept Technology (ERINT): Extended Range Intercept Technology, a small, hit-to-kill missile, funded by BMDO, provides asset defense against maneuvering and non-maneuvering TBMs with a secondary objective of providing defense against the ABT. Designed to be compatible with existing and planned air defense systems, the missile combines several state-of-the-art technologies; as it undergoes a series of flight tests during FY 93. This technology program is a potential solution to meet PATRIOT PAC-3 missile operational requirements.

Theater High Altitude Area Defense (THAAD): The THAAD system is a key element of the GPALS architecture; the material solution to the High Altitude Theater Missile Defense (HATMD) requirement (defense against theater/strategic missile threats to the US and Allied/host nation forces and key geopolitical assets). It includes the TMD-Ground Based Radar (TMD-GBR), launcher and missile. THAAD kills TBMs at long ranges and high altitudes and operates in an enclave with PATRIOT. Its long range surveillance and intercept capability protects wide areas, dispersed assets and population centers against TBM attacks. The TMD-GBR integrates with the theater air defense BM/C3I architecture and provides surveillance and target cueing information to conventional theater air defense systems such as PATRIOT/TSAM and CORPSSAM. The THAAD system is a major system new start. Fieldable, DEM/VAL THAAD equipment forms the User Operational Evaluation System (UOES). The UOES is used for early operational testing; it will be available for deployment in case of a national emergency, if required. With delivery of the UOES in 1996, we have a near-term TBM capability; it will be available until the year 2000+ when the objective system should be ready.

CORPS SAM: CORPS SAM replaces the HAWK system. CORPS SAM is envisioned as the future centerpiece of CAAD. It is a strategically deployable, tactically mobile, low-to-medium altitude air defense system for corps and reinforcing divisions in global, major regional, and lesser regional conflict areas. Conceptually, this system consists of modular components which allow tasks organization and equipment configuration according to all array of expected air threats, available strategic lift, and acceptable level of risk. The system will provide defense capabilities against TBMs, CMs, and other threats. CORPS SAM is an integrated part of the overall AD/TMD architecture and is able to interface with Joint and Allied sensors and C3I networks. The concept formulation and development of CORPS SAM considers the evolution of currently fielded, as well as developmental, systems and components. We will aggressively explore opportunities for cooperation with Allies in order to reduce costs and enhance commonality/interoperability.

HAWK: HAWK is the Army's primary low-to-medium altitude air defense system; it provides defense of critical assets and maneuver forces. HAWK is a mature system which has evolved over the years through technology upgrades that have improved performance while significantly reducing operating and support (O&S) costs. Additional evolution following the current Phase III modifications (multiple-simultaneous engagement of low altitude targets, improved Electronic Protection (EP), and replacement of heavy data cables with lightweight field wire) is no longer cost effective. However, HAWK is also currently is use in the USMC and over 20 foreign countries.

Extended Air Defense Test Bed (EADTB): EADTB is a computer simulation capability used to conduct analysis of current and future air defense systems effectiveness against aircraft, and tactical ballistic missiles. EADTB is planned to be available in October 1993, at Huntsville, AL, Ft. Bliss, TX, and Kirkland AFB, NM.

National Missile Defense (NMD): NMD is a Congressionally mandated system to counter the ICBM and SLBM threat to the Continental United States (CONUS). NMD may consist of a ground based interceptor element (GBI), a ground based radar (GBR), sensor probe and/or space based sensor (Brilliant Eyes), and a BM/C3 element (ROC) required to interface with US Space Command and other elements of the Global Protection Against Limited Strikes (GPALS) system.

- Ground Based Interceptor (GBI) is the NMD Interceptor. It is a low cost, hit-to-kill missile designed for exo-atmospheric intercept of ICBM and SLBM reentry vehicles during midcourse flight.

- NMD - Ground Based Radar (NMD-GBR) is similar in design and operation to the TMD-GBR but has a larger array face for greater range and search area. NMD-GBR provides acquisition and track information for the GBI.

- Regional Operations Center (ROC) provides site control capability for NMD systems; it is linked to US Space Command for overall battle management direction.

- Ground-Based Surveillance and Tracking System (GSTS) is a ground based sensor probe launched upon cueing from the constellation of Brilliant Eyes to provide additional data for launch of the GBI.

- Brilliant Eyes are Air Force space based sensors which provide surveillance, tracking and cueing data for the GBI.

Theater Missile Defense Hypervelocity Gun system (HVG): HVG demonstrates an area tactical missile defense capability using electromagnetic, electrothermal, or SCRAMJET launchers and hit-to-kill hypervelocity guided projectiles. Within the theater of operation, HVG performs active defense of critical assets and conducts attack operations against ground based targets (mobile missile launchers) at ranges up to 400 km.

Air Defense Sensors.

The operational strategy for air defense employment and the increasing complexity of target acquisition, air breathing and ballistic missile threats, coupled with low observable technologies, emphasize the need for a decentralized C3I architecture. A distributed C3I architecture allows deployment and operation of sensor nodes independent of tactical operations centers and fire units. Conceptually, this distributed architecture is an extension of the HIMAD and Joint air control/air defense data linkages.

- Light and Special Division Interim Sensor (LSDIS) is being procured as an interim sensor for the Ground Based Sensor (GBS) in light and special divisions, and the 2nd Infantry Division. LSDIS provides a near term capability (replaces the already extinct Forward Area Alert Radar (FAAR) at a moderate cost until the more capable GBS is fielded.

- FAADS GBS provides critical air surveillance in divisions and selected corps. The system consists of a sensor, FAADs C3I interface, vehicle, generator and IFF/Selective Identification Feature (SIF). It provides acquisition, tracking, classification, and identification of fixed and rotary wing aircraft and UAVs. It also provides locations of targets sufficient to cue the AVENGER and is capable of acquisition and tracking in EA environment and clutter. The sensors offer 360 degree continuous volume surveillance of friendly and hostile aircraft. The GBS is capable of day and night operation, in all weather, and in dust, smoke, aerosol, and threat countermeasures environment.

- Identification. The dynamic nature of the battle field requires forces to engage the right targets at the right times and places on the battlefield, and to capitalize on the beyond visual range (BVR) capabilities of today's weapon systems. Positive identification -- to prevent fratricide -- is a major mission area need for Air Defense Artillery, Close Combat, and Aviation. Non-Cooperative Target Recognition (NCTR) devices are to be employed on some air defense weapons. Near and Mid-term developmental efforts focus on: improving detection and positive identification performance of NCTR systems developed for AVENGER and GBS; expanding NCTR capabilities to other air defense weapon systems; and, exploiting the inherent passive target acquisition capabilities of NCTR systems.

Air Defense C3I Integration.

C3I is a combat multiplier. Each air defense weapon system has a unique fire control system which does not, in all cases, communicate/interoperate with other air defense weapon systems and the maneuver forces of other services. Air defense modernization clearly calls for improvements in C3I capabilities. The key to implementing a robust ADA C3I is the design of a distributed architecture that integrates external sensor and intelligence data, on a near real time basis, and distributes this information to battlefield users. Success in this vital area will greatly enhance air defense effectiveness.

- HIMAD C3I is comprised of battalion and brigade level fire direction centers (FDC), battery through brigade level command posts, and the requisite communications to support engagement and force operations. Currently, the Information and Coordination Central (ICC) provides fire direction in PATRIOT battalions while the AN/TSQ-73 Missile Minder provides fire direction for Hawk battalions and corps and theater ADA brigades. HIMAD command posts exchange information over voice channels by automatic data links and tele-facsimile. All reporting is recorded manually by communications operators. The Army is moving toward a family of common hardware and software Air Defense Tactical Operations Centers (ADTOCs) for battery through theater levels. The ADTOC supports PATRIOT, ERINT, CORPS SAM, and THAAD.

- FAADS Command and Control (C2) system is a combination of hardware and software that enables robots, distributed acquisition and identification, optimum employment of weapons, reduction of fratricide, and distribution of air threat and air battle control information to ground forces. The design of the Air Battle Management Operations Center (ABMOC) and Army Airspace Command and Control (A2C2) permits these two functions to operate independent of each other and be operated by different battalion staff personnel.

Technology Base Contributions.

Technology will be inserted through block improvements to current and next generation weapon systems. Advanced technologies which are producible and affordable will be integrated into system new starts. As a result of the multi-dimensional air defense mission, the air defense technology base effort has many facets and includes many capabilities.

Summary.

The Army Air Defense will most likely be the lead on the cruise missile defense mission. Our current weapons suite (as demonstrated in SWA) is not prepared for this challenging role. As a result, current planning is to improve/upgrade PATRIOT to something perhaps less than a full-blown PAC 3 by improving radar and missile elements. Fusing and endgame capability needs upgrading to improve system lethality. In addition to cruise and tactical ballistic missiles, the threat includes fixed and rotary wing aircraft, air-to-surface missiles and reconnaissance drones.

The Army should also push for THAD and Corps SAM for an effective active defense. Corps SAM uses a distributed/netted architecture to pass and receive target data from many sources including AWACS and Rivet Joint Electronics Intelligence aircraft. All services will rely on a combination of sensors to gather information that can be sifted for targets. Radar can be augmented by infrared search and track, acoustic and electronic support measures (ESM).

Corps SAM will have 16 missiles/launchers and over 100 in a single battery. It will be able to acquire and track hundreds of targets and is designed to be airlifted for early deployment. It is currently the only system in planning that can handle multiple targets at one time.

The Army will share the Navy and Air Force problem of having a missile fly up and then look down toward Earth to find a target. Sensors will look for movement, heat, and radar returns. Large amounts of processing power will be used to filter target images out of the ground clutter. Developing a technique to address a low observable cruise missile will end up being a huge problem. This surveillance task is one of the more difficult at the present time.

Even a small business jet could be turned into a cruise missile with five tons of high explosives, a television camera for takeoff, autopilot, GPS, and a cheap navigation system.

A Pentagon report (AW&ST, March 22, 1993, page 47) predicts that soon after the year 2000, China, Iran, and Syria will all have operational cruise missiles with low observable characteristics, such as diffused and downward pointing exhausts, and reduced radar cross sections capable of flight at low altitudes. In addition to conventional high explosives, there will be chemical, biological, and, in the case of China, nuclear warheads sized to the weapons (AW&ST, Feb 1, p26).

The AD community is ripe for wholesale improvements in digitization technology to enhance large data transfer and Combat Identification/IFF technologies to insure that our systems won't be likely to commit fraticide. Brilliant Eyes are Air Force space based sensors which provide surveillance, tracking and cueing data for the GBI.

AIR DEFENSE BASECASE			
MISSION AREAS	NEAR-TERM (FY 94-95)	MID-TERM (FY 96-99)	FAR-TERM (FY 00-08)
Forward Area Air Defense	STINGER RMP MANPADS BSFV FAADS C3I LSDIS GBS	STINGER RMP MANPADS AVENGER BSFV GBS/LSDIS FAADS C3I CAI	STINGER RMP MANPADS AVENGER BSFV GBS/LSDIS FAADS C3I CAI
Corps Area Air Defense	PATRIOT HAWK PH III CHAPARRAL STINGER RMP	PATRIOT PAC3 HAWK PH III AVENGER CHAPARRAL	PATRIOTT PAC3 HAWK AVENGER CORPS SAM
Theater Area Air Defense *and* Theater Strategic Air Defense	PATRIOT HAWK PH III CHAPARRAL	PATRIOT PAC3 THAAD UOES HAWK PH III AVENGER	PATRIOT PAC3 THAAD CORPS SAM AVENGER
Strategic		UMD UOES	NMD

TACTICAL WHEELED VEHICLES.

Tactical wheeled vehicles (TWV) are the backbone of the Army's support and sustainment structure. TWVs provide mobility on and off the battlefield. Trucks transport personnel, munitions, replacement combat vehicles, petroleum products, critical supply items, and combat casualties. They are also platforms and prime movers for command, control, communications, computers and intelligence (C4I) systems and selected weapon systems.

Systems vs. Technologies Matrix.

Since many of the technologies associated with Horizontal Technology Integration involve integration into the vehicle rather than use on the vehicle, most candidate horizontal technologies will apply indirectly to tactical wheeled vehicles. For example, use of night vision systems can be fruitfully employed on tactical wheeled vehicles but are not inherently part of the vehicle design.

Although tactical wheeled vehicles represent large quantities of Army assets, they are of relatively low unit cost, and therefore do not represent a substantial portion of the Army's investment budget. The FY 1994 proposed budget is approximately $800M. The greatest opportunities for improvement to the TWV fleet lie in improving its reliability and reducing the cost of ownership. This will, in addition, provide improved readiness.

Systems Discussion.

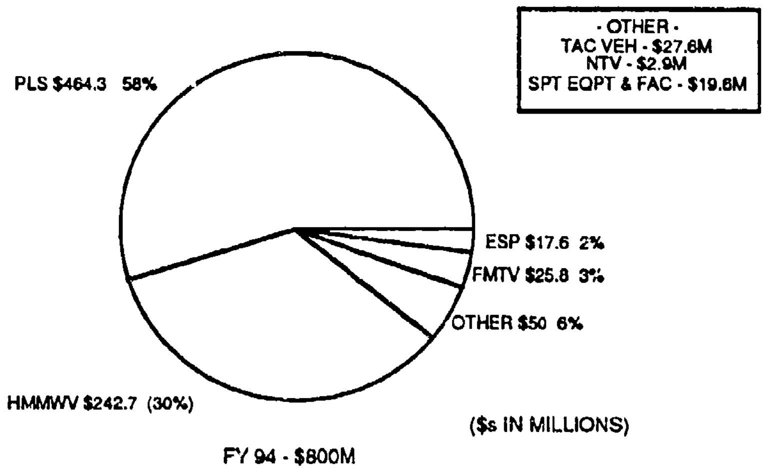
The Army divides the tactical wheeled vehicle family into three categories—light, medium, and heavy. As their designations imply, the categories are associated with their size, weight, and power requirements—along with the types of cargoes they must move. The Chart below describes the systems by category, and indicates current planning for fleet retirements and/or upgrades.

TACTICAL WHEELED VEHICLES: CAPABILITY/NEEDS	
LINE FLEET	
HIGH MOBILITY MULTIPURPOSE WHEELED VEHICLE, HMMWV	FULLY CAPABLE, CONTINUE PROCUREMENT
COMMERCIAL UTILITY CARGO VEHICLE, CUCV	CAPABLE, BUT AGING; NEEDS REPLACEMENT
SMALL UNIT SUPPORT VEHICLE, SUSV	CAPABLE—SNOW & MOUNTAINS MINOR PROD IMPROVEMENTS REQ'D
JEEP, M151 M880	OVERAGE, REPLACE WITH HMMWV OR CUCV
ARMORED SECURITY VEHICLE, ASV	CAPABLE FOR URBAN OR CONVOY SUPPORT— PROCURE IN 1994
MEDIUM FLEET	
2 1/2 TON TRUCK	OVERAGE, MAINTENANCE BURDEN RETIRE/SERVICE LIFE EXTENSION PROGRAM (SLEP)
LIGHT MEDIUM TACTICAL VEHICLE (LMTV)	FULLY CAPABLE —REPLACES 2 1/2 TON
5 TON TRUCK	RETIRE OLDER UNITS UPGRADE M939 TO M939A1/A2
MEDIUM TACTICAL VEHICLE (MTV)	FULLY CAPABLE, REPLACES 5 TON
HEAVY FLEET	
PALLETIZED LOAD SYSTEM (PLS)	FULLY CAPABLE, BUY OUT IN FY94
HEAVY EXPANDED MOBILITY TACTICAL TRUCK (HEMTT)	FULLY CAPABLE, RETAIN
HEAVY EQUIPMENT TRANSPORTER (HET)	FULLY CAPABLE (NEW); DEFICIENT (OLD)
LINE HAUL TRACTOR (M915) LINE EQUIPMENT TRANS (LET) M916 MEDIUM EQUIPMENT TRANS (MET) M920	CAPABLE CAPABLE CAPABLE, BUT AGING
10 TON TRACTOR, M123	DEFICIENT, OVERAGE, RETIRE

The illustration below provides a breakout of the FY94 procurement budget for tactical wheeled vehicles. It can be seen that 58% of the budget is devoted to a buy-out of the palletized load system (PLS) while an additional 30% is spent on additional procurement of the high mobility multipurpose wheeled vehicle (HMMWV). It is noted that these procurements will satisfy the FPI and FPII requirements for the PLS through 2012 and will satisfy the HMMWV FPI requirements through 2002. There are approximately 80,000 HMMWVs in the Army today.

FIGURE 2.2.7-2

OTHER PROCUREMENT, ARMY TACTICAL AND SUPPORT VEHICLES



Capabilities.

The systems identified in the table on the previous page constitute the current capabilities throughout the wheeled vehicle fleet. By and large, the newer vehicles are fully capable of satisfying current and near term requirements. The main shortfalls arise in connection with the deficiencies of the older, less capable and less reliable vehicles. Continuous fleet upgrades via retirement of deficient equipment and insertion of newer vehicles and/or product improvements can satisfy known requirements.

Technology.

Technology insertion in the tactical wheeled vehicle fleet centers primarily around two factors:

- Providing the ability to carry the types of equipment necessary to achieve horizontal integration throughout the Army.
- Inserting the appropriate improvements necessary to reduce operations & maintenance (O&M) cost and achieve improved readiness.

These objectives can, in general, be met with modest R&D investments. Current fleet planning calls for the sequential modernization of Force Packages I through IV. The next table identifies the timing of modernization of Force Package I (FPI) and Force Package II (FPII).

TACTICAL WHEELED VEHICLE UPGRADE PLAN				
		FPI	FPII	NOTES
LIGHT FLEET	HMMWV	OK THRU '12	OK THRU '02	RETIRE M151, M880
MEDIUM FLEET	2 1/2 TON LMTV	INTRODUCE LMTV '94 - '98	INTRODUCE LMTV -'99 -'09	RETIRE 2 1/2 TON TRUCKS ASAP
	5 TON MTV	INTRODUCE MTV '94 - '02 (USE M939A2 IN INTERIM)	INTRODUCE MTV '03-'11(USE M939, M939A1, M939A2)	RETIRE M939
HEAVY FLEET	PLS	FILLED FY '94	FILLED BY '95	FP III/IV NEVER SATISFIED
	HEMTT	OK THRU '06	OK THRU '09	FP IV/IV OK THRU '01
	M915 LINE HAUL TRACTOR	M915A1/A2 THRU '03	M915/M915A1 THRU '01	NO NEW PROCUREMENT PLANNED
	M916 LIGHT EQUIP TRANSPORTER	M916A THRU '12	M916 THRU '01	PORTIONS OF FLEET OVERAGE IN 2000
	M920 MEDIUM EQUIP TRANSPORTER	M920 THRU 2000	M920 THRU 2000	FLEET OK THRU 2000
	M1070 HEAVY EQUIP TRANSPORTER	OK THRU '07	OVERAGE BY '95 SLEP REQUIRED	SLEP OR NEW PROCUREMENT NEEDED FOR FPIII

Conclusions.

Tactical wheeled vehicles constitute an integral part of today's Army which emphasizes the importance of readiness and worldwide mobility. Although these vehicles tend to be less sophisticated than much of the Army's equipment, it is imperative that this fundamental capability be retained if the U.S. Army is to be capable of placing lethal, versatile forces anywhere in the world on short notice. Modest, continuing investments will be necessary to achieve reliability goals and reduce operating costs.

Opportunities.

There are limited opportunities for aggressive technology insertion. Wheeled vehicles, however, must continue to be upgraded so that reliability can be continually improved and maintenance can be reduced.

It is noted that while current Army plans call for emphasis on light, mobile contingency forces, little has been done to improve vehicle mobility and agility with this operational concept. For this reason, it is recommended that around $75M-$100M be devoted to pursue new vehicle designs in the 1994-1999 time frame.

FIRE SUPPORT.

Fire Support systems are the integral element of US Army warfighting capabilities. This area supports the Army objectives of Protect the Force, Conduct Precision Strikes, and Dominate the Maneuver Battle. The general objective of fire support is simple. That is to provide those elements necessary for land

force dominance! Fire Support is the collective and coordinated use of indirect fires, target acquisition data, armed aircraft, and other lethal and nonlethal means against ground targets in support of maneuver force operations. The mission of fire support is to destroy, neutralize, or suppress the enemy with indirect fires and integrate all available means of fire support. The following discussion will summarize the subject area. It will address the systems, technologies, and support structure required for the Army to meet their future needs. It contains an estimate of current capabilities as well as an estimate of the effect of different changes/modernization(s) proposed for general Army systems.

Systems Considered.

The systems considered, together with the results of the winnowing are shown in the Table below. The strike-through indicates that the system was set aside as not a primary candidate

SYSTEMS USED IN FIRE SUPPORT			
TARGET ACQUISITION		COMMAND AND CONTROL	
~~Q36 COUNTERMORTAR~~	[3,4]	~~TACFIRE~~	[5,6]
~~Q37 COUNTERFIRE RADAR~~	[4]	~~LTACFIRE~~	[5,6]
~~FIST-V~~	[2]	AFATDS	[7]
~~OV1 MOHAWK~~	[2]		
~~GUARD RAIL~~	[2,6]		
~~NATIONAL ASSETS~~	[1]		
~~OH-58D~~	[2]		
~~JSTARS~~	[2]		
~~UAV~~	[2,6]		
~~QUICK FIX~~	[2]		
WEAPONS AND MUNITIONS		SUPPORT AND SUSTAINMENT	
Mortars		~~MDS~~	[4]
M101A1 (105mm)	[7]	~~MMS~~	[4]
M102 (105mm)	[7]	~~90 Chronograph~~	[5]
M119A1 (105mm)	[7]	~~PADS~~	[4]
M114A2 (155mm)	[5]	M548	
M198 (155mm)	[4]	FAASV	[8]
~~M109A2/A3 (SP How)~~	[3,4]	FARV	[7]
~~M109A5/A6 (SP How)~~	[3,4]		
~~M270 MLRS~~	[3,4]		
HELLFIRE	[8]		
Copperhead	[8]		
~~ICM/DPICM~~	[4]		
HE	[8]		
~~FASCAM~~	[4]		
~~MLRS DPICM~~	[4]		
ATACMS	[7]		
AFAS	[8]		
BAT			
SADARM			

for upgrade. The reason for the set aside, keyed to the paragraph above, are shown in the brackets. As seen in the Table below, most of the listed systems, for a variety of reasons, were found not to be candidates for upgrade. A few are candidates for technology insertion. It is of some value to note that in both Command and Control as well as in Target Acquisition almost every item is struck. Support and Sustainment have but three non-struck. The area of key interest/need are Weapons and Munitions where

a good number survive. We should perhaps discuss these a bit, but I believe in general, the selections are correct.

Operational Needs.

The battlefield where the U.S. Army will utilize those systems and components, discussed herein, will place new demands on the fire support system. The strong requirement to achieve land force dominance with minimum losses places the emphasis on technology and its utilization in smart weapons/munitions. The U.S. does not currently have the capability of using the "saturation use of fires" as a strategy. In the past, the demand for fires has been achieved by increasing the number of weapons. With the smaller force and constrained resources, technology is leveraged to provide a requisite increase in combat power.

Such a situation enables one to make fairly broad, but easy, decisions on priorities and hence on acquisition strategy. Every event will in its worst case lead to conflict. That conflict will lead to a force-on-force engagement. In order for us to win that engagement, we will be required to have the technological dominance that meets our national requirement described above. That dominance will end up being required in the weapons and munitions arena.

Current Capabilities.

Fire Support contains a wide variety of systems. Leaving the platforms to areas discussed elsewhere in this document (i.e., armor), forgetting the air defense objective, and likewise leaving the reconnaisance, intelligence, surveillance and target acquisition (RISTA) for other sections, we are left with weapons. These weapons include cannons, rockets, missile systems and theater ballistic missiles. Even though the Gulf War left us with an impression we are superior in capability, the hard facts bear some thought. Quantitatively, we are inferior, especially if we do battle with an enemy who can effectively use their resources and be a serious force to fight or deal with.

The first set of data addresses our 155mm cannon compared to the capabilities being produced elsewhere. We are clearly outranged and have a serious problem in a direct firefight. This was well known in the Gulf, but not seriously addressed because the Iraq command and control never was able to bring effective fire on our assets.

The second area is rocket and small missile systems. MLRS is the best we have to offer. The situation in this area is quite analogous to the cannon system. Perhaps most critical, is the fact that those rocket based systems can deliver chemical agents and this could be disastrous in a future conflict. Each of these systems is hard to cope with because of inherent mobility. Only those systems are cited that are most common in the world weapons markets.

The larger theater ballistic missiles are not quite as serious but the U.S. Army does have a disadvantage. These are generally described as subsonic, ground-hugging, low observable cruise missiles. They are cheaper and easier to build than ballistic missiles. Their routes are far less predictable than a ballistic missile. As we found in the Gulf, their mobility makes them difficult to defend against. Even a small business jet could be turned into a cruise missile with explosives, a TV camera for takeoff and targeting, and autopilot, GPS and a simple navigation system. This problem will be very difficult for the Army of tomorrow to address. Only technology will solve it and the priority is critical.

Technologies.

The fire support mission and capability to perform that mission is made possible by the application of current and emerging technologies. Perhaps the single greatest advantage that is to be achieved is the reduction of the logistics chain due to increased probabilities of hit and kill using modern weapons. The most significant contributions of technology in the fire support area are:

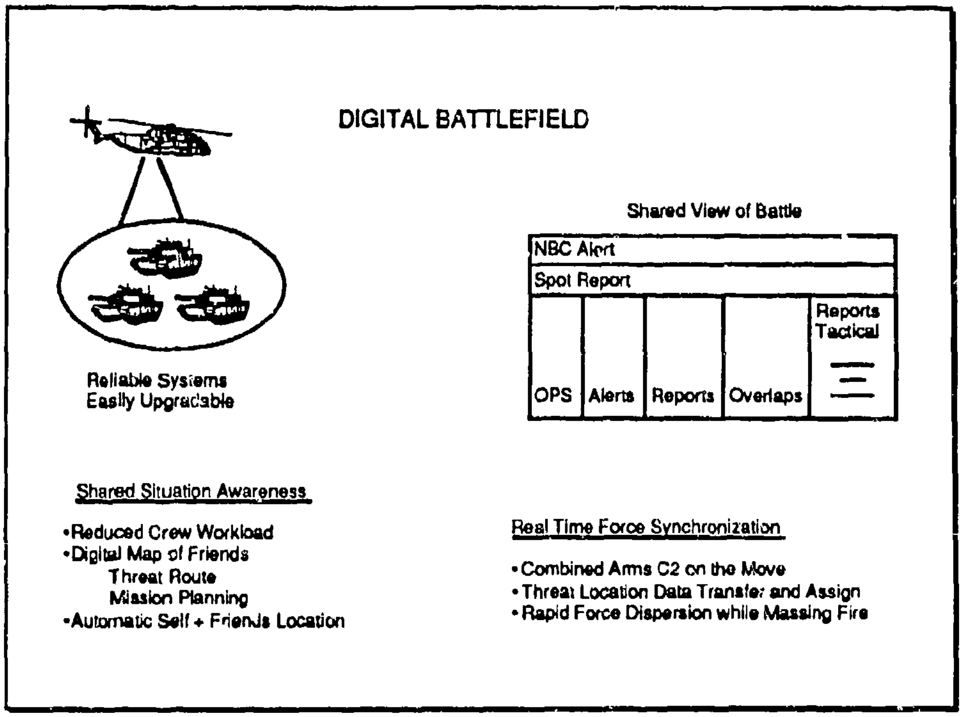
- Target Acquisition: This advanced capability primarily supports the "own the night" objective. The future battlefield will be characterized by fast-moving forces and unprecedented lethality. Real-time

data will be required to develop intelligence and to synchronize the employment of forces and systems to destroy the evenings capacity to wage war. Deep acquisition, coupled with more accurate longer range fire and improved real time acquisition will permit success at increased range, either laterally or in depth.

- Long Range Weapons: This capability will provide us with the wherewithal (i.e. modern artillery, attack helicopters, and missiles with adequate range). Munitions must include those that can precisely destroy moving vehicles and high priority mobile targets such as mobile missile launchers. Against maneuvering formations, we must concentrate and coordinate indirect fire along with massed helicopter attacks.

- Smart Munitions: Improved munitions will provide increased lethality needed by fewer forces. The capability to detect and kill targets at long range will have a tremendous leverage on the logistics burden. With the current strategy of a contingency force being used to be first in theater, smart munitions can provide the firepower required for armor to survive until help can arrive. Smart munitions will be necessary in MOUT and where surgical strikes are required. It should be noted that the IFF problem becomes more acute with the implementation of greater quantities of smart munitions together with the supporting capabilities (i.e. RISTA, Digital Battlefield Communications, etc.).

- Automation: The assimilation, processing, and dissemination of intelligence will be dramatically improved by digitization of the battlefield. To win the battlefield information war, the Army must have the capability to gather information, process it, transmit it around the battlefield and deny the enemy the same capability. Sensors that locate and identify targets, intelligence fusion systems, smart munitions and systems that destroy or disrupt the enemy's information flow are essential for decisive operations. A schematic idea of what this effect will be is given in the illustration below:



From the above discussion, it would appear that there are a number of technology insertion opportunities as follows:

Command and Control.

Current systems do not have the modern capabilities required to manage all systems encountered. Assuming that digitization of most systems occurs as planned, the future requirements will be met.

Modernization.

- AFATDS (Advanced Field Artillery Tactical Data System
- M109A6 (Paladin)
- AFAS

Support and Sustainment.

Current capabilities are old, have high maintenance, have high operating costs, and are hard to deploy. However, systems coming along will clearly address most of the issues cited if they modernize.

Modernization:
- FARV
- PLS
- MVS

Munitions.

The M109A6 Palladin Howitzer provides range, survivability, and lethality needed at present. In the long term, an AFAS system is needed to solve crew size problems as well as range and lethality issues. The rocket and missile systems are the backbone of deep range strike capabilities. Finally ammunition cannot be forgotten. We need clear improvements to all projectiles, rockets, shells and missiles if we are to achieve fire superiority.

Modernization.

- M109 A6
- Palladin
- AFAS
- IFCS
- HIMARS
- SADARM
- BAT
- STAFF
- WAM
- ATACMS
- Hellfire
- Longbow

Conclusions.

- Fire support is behind potential enemies in capabilities.
- We have things "in the pipeline" that can address the issues that face us.
- The key challenge is a prioritization of the elements of modernization to play against available funds.
- Some systems currently used are not candidates for upgrade.
- Ensure that some of the activities currently underway for improvement continue so that some force element (TBD) achieves the use of them.

System Limitations and Promising Technology Insertions.

The firepower capability of the U.S. Army is very good. However, as noted earlier in this chapter, individual weapons (i.e. 155mm) are outranged by competitive devices that are manufactured elsewhere. With the insertion of brilliant munitions and the development of new systems/capabilities, such as AFAS, these differences will be generally eliminated.

One of the most critical areas of application is in the AFATDS (Advanced Field Artillery Tactical Data System). This system broadens and modernizes the Army's Fire Support within the ATCCS architecture to support planning and execution of close combat, counterfire, and deep battle operations. AFADTS automatically implements a commander's detailed guidance of operational planning and execution to include increment control, target value analysis, fire support coordination, and attack. AFATDS is capable of performing required FS C3 functions at any level of command. It provides full fire support functionality in support of all levels of conflict, at all echelons of fire support and maneuver, to include field artillery, mortar, naval gunfire, and tactical air. The AFATDS system replaces TACFIRE in the heavy division and LTACFIRE in light and special purpose divisions. Moreover, AFATDS better links target acquisition systems with the delivery system.

Technology Assessment

Thrust	Advanced Land Combat Vehicles				
Function	Move	Shoot	Survive	Communicate	Support
What we would Buy	• Signature Control • Advanced armor and Gun/Missile Systems • Lighter, more reliable and more sustainable vehicles				
Technologies	Software Engr Composite Mtls	Software Engr Mach Intelligence Passive Sensors Signal/Image Processing Weapons Systems Data Fusion Computational Fluid Dynamics Warheads Energetics	Software Engr Machine Intelligence Passive Sensors Signal/Image Processing Signature Control Weapons Systems Composite Matls	Photronics Signal & Image Processing Signature Control	Machine Intelligence Robotics

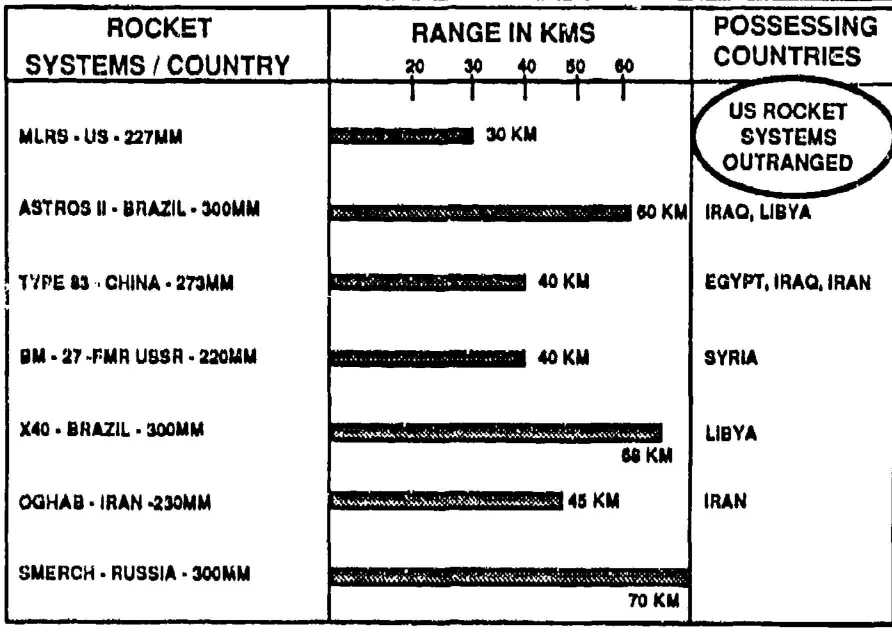
Although it is but a support element to Fire Support, the FARV program is essential to the success of any future heavy or light division. As was proven in Desert Storm, the supply/resupply is as important as the performance of weapons systems. Thus we must ensure the FARV is developed.

AFAS is the centerpiece of fire support modernization. It will reduce manpower requirements and exploit technology to improve reliability, responsiveness and survivability. AFAS is a much more capable howitzer with a greatly reduced crew and provides about twice the effectiveness of Palladin. It will finally close the range gap that exists with foreign systems. It will provide the mobility and survivability needed to keep pace with fast paced maneuver operations. We must sustain the five goals:

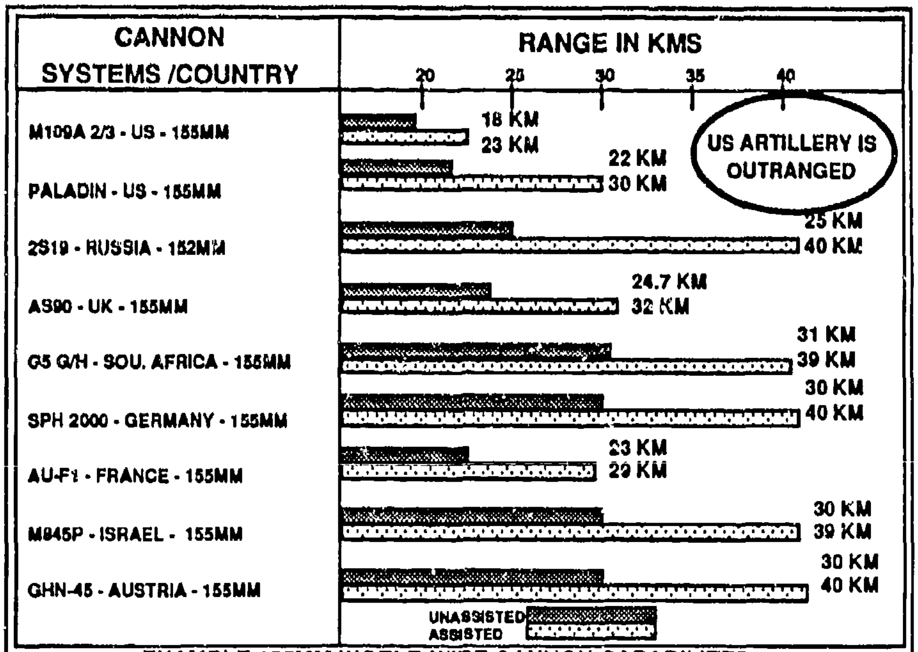
1) Increased Accuracy.
2) Increased range and rate of fire.
3) Reduced vulnerability to counterfire.
4) Increased mobility and
5) Reduced personnel.

This is the clear answer to the future needs of the Army.

Brilliant or Smart Munitions are the killing end of fire support. The U.S. Army must have significant improvements in projectiles, rockets, and missiles if we want to realize full advantage of our modernized cannons and launchers.



PROLIFERATION OF ROCKETS AND MISSILE SYSTEMS



EXAMPLE 155MM WORLD WIDE CANNON CAPABILITES

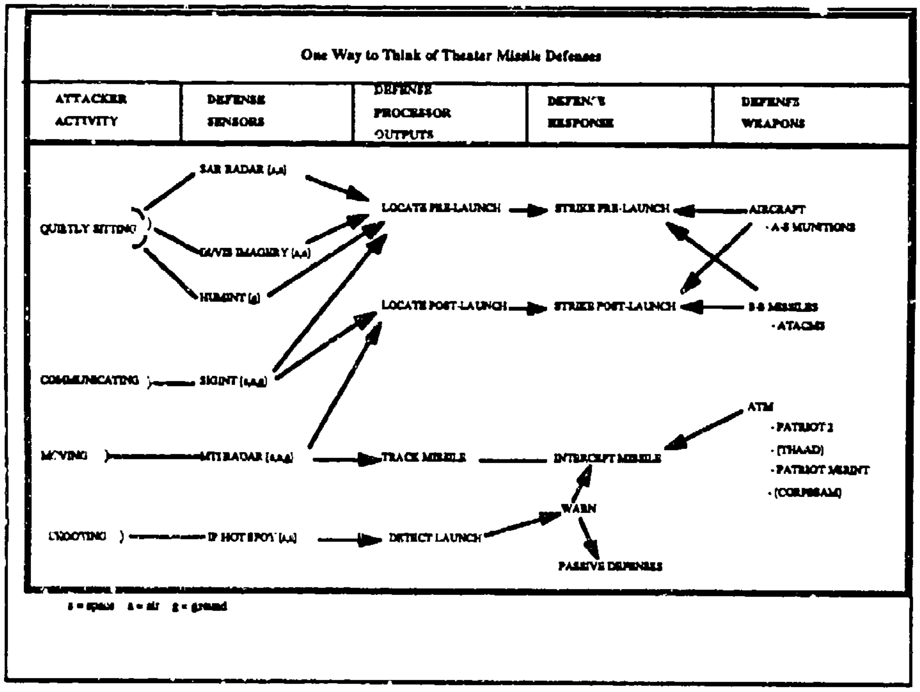
Continued procurement and development of intelligent munitions into the far term provides fire support with a long overdue, fire-and-forget capability. It is the only practical method of resolving the current existing firepower differences as well as being able to execute our national policy of winning fast with numerically lesser forces. In addition, the capability to detect and kill targets at long range with high kill

probabilities will significantly impact logistics. Smart munitions can provide the anti-armor punch lacking in early deployed light forces. They will also be required in MOUT and when surgical precision is required. One thing to keep in mind, brilliant munitions will increase accuracy, but they will put new demands on positive combat identification.

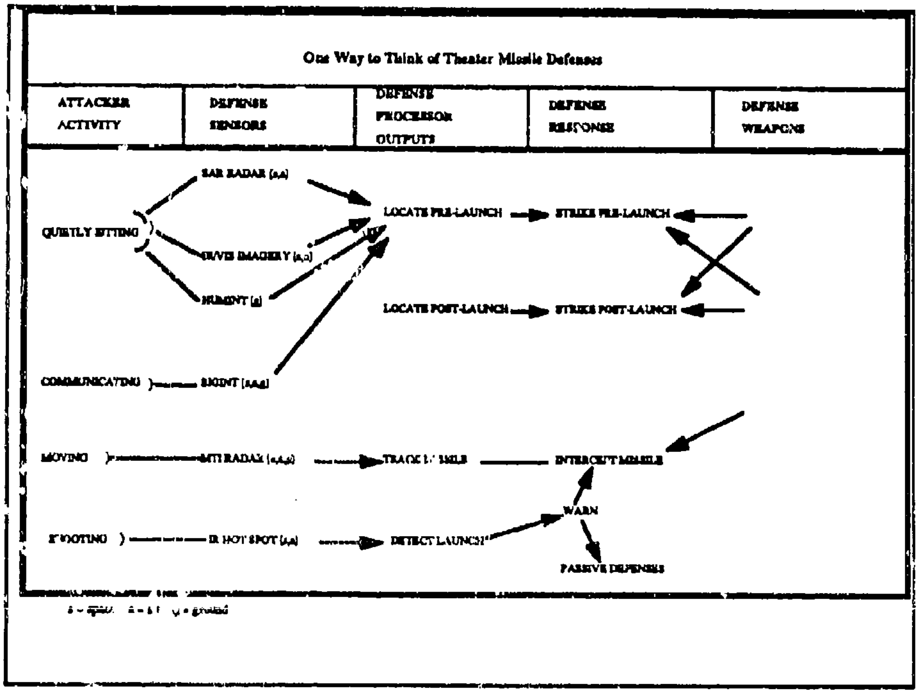
The Table below arrays the identified technologies vs. systems or munitions subsystems for which their application is assessed to be appropriate. It also includes estimates of the number of systems that would have to be acquired to equip Force Package I portion of the mid-term Army.

FIRE SUPPORT HORIZONTAL AND VERTICAL TECHNOLOGY INTEGRATION OPTIONS								
		HORIZONTAL TECHNOLOGY INTEGRATION						
SYSTEM	NBR SYS RQD	IFF	SECOND GEN FLIR	POS/NAV SYSTEM	COMMAND CONTROL DIGIT.	SURV ENSEMBLE VIDS	BRILLIANT MUNITIONS	VERTICAL SYSTEM TECHNOLOGY INSERTION
FAASV		***		***				
FARV	NA	***		***	L1	L1		
AFATDS		***			L1	L1	***	
M101A1				***			***	
M102				***			***	
M119A1	406			***			***	
M114A2	582			***			***	
M198				***			***	
M109A2/A3				***			***	
M109A5/A6	420/425			***			***	
HELLFIRE	***							
COPPERHEAD	***							
ATACMS	NA	***			L2	L2	***	NEED FAM OF MUN.
AFAS		***		***	L3	L3	***	STD PLATFORM
BAT	400K							
SADARM	20K							AP, ANTI HOWITZER/AT
STAFF	200K							
WAM	400K							BROADEN??
LONGBOW	NA							

SYSTEMS USED IN FIRE SUPPORT			
TARGET ACQUISITION		**COMMAND AND CONTROL**	
~~Q36 COUNTERMORTAR~~	[3,4]	~~TACFIRE~~	[5,6]
~~Q37 COUNTERFIRE RADAR~~	[4]	~~LTACFIRE~~	[5,6]
~~FIST-V~~	[2]	AFATDS	[7]
~~OV1 MOHAWK~~	[2]		
~~GUARD RAIL~~	[2,6]		
~~NATIONAL ASSETS~~	[1]		
~~OH-58D~~	[2]		
~~JSTARS~~	[2]		
~~UAV~~	[2,6]		
~~QUICK FIX~~	[2]		
WEAPONS AND MUNITIONS		**SUPPORT AND SUSTAINMENT**	
Mortars		~~MDS~~	[4]
M101A1 (105mm)	[7]	~~MMS~~	[4]
M102 (105mm)	[7]	~~90—Chronograph~~	[5]
M119A1 (105mm)	[7]	~~PADS~~	[4]
M114A2 (155mm)	[5]	M548	
M198 (155mm)	[4]	FAASV	[8]
~~M109A2/A3 (SP How)~~	[3,4]	FARV	[7]
~~M109A5/A6 (SP How)~~	[3,4]		
~~M270 MLRS~~	[3,4]		
HELLFIRE	[8]		
Copperhead	[8]		
~~ICM/DPICM~~	[4]		
HE	[8]		
~~FASCAM~~	[4]		
~~MLRS DPICM~~	[4]		
ATACMS	[7]		
AFAS	[8]		
BAT			
SADARM			



One Way to Think of Theater Missile Defenses
ATTACKER ACTIVITY
DEFENSE SENSORS
DEFENSE PROCESSOR OUTPUTS
DEFENSE RESPONSE
DEFENSE WEAPONS
QUIETLY SITTING
COMMUNICATING
MOVING
SAR RADAR (s,a)
HUMINT (g)
SIGINT (s,a,g)
MTI RADAR (s,a,g)
IR HOT SPOT (s,a)
LOCATE PRE-LAUNCH
LOCATE POST-LAUNCH
TRACK MISSILE
DETECT LAUNCH
STRIKE PRE-LAUNCH
STRIKE POST-LAUNCH
INTERCEPT MISSILE
WARN
PASSIVE DEFENSES
AIRCRAFT
- A-S MUNITIONS
S-S MISSILES
- ATACMS
ATM
- PATRIOT 2
- (THAAD)
- (CORPSSAM)
s = space a = air g = ground



One Way to Think of Theater Missile Defenses
ATTACKER ACTIVITY
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HUMINT (g)
SIGINT (s,a,g)
LOCATE PRE-LAUNCH
LOCATE POST-LAUNCH
STRIKE PRE-LAUNCH
STRIKE POST-LAUNCH
INTERCEPT MISSILE
WARN
PASSIVE DEFENSES

ACQUISITION IMPLICATIONS OF TMD HTI AND VTI OPPORTUNITIES (all cost nbrs are dch uswags)										
	PROCUREMENT PACKAGE	TYPE PROG.	HTI/TI PRODUCT DEV/PRODUCER	PRODUCT-SYS INTEGRATOR	RDTE COST $ M	UNIT COST $ K	NR. RQD (FP1)	PROD. COST $ M	INTEGR COST $ M	TOTAL INVEST $ M
LOC. TBM LNCHR	TPQ37 UPGRADE	III	CUR CONT.	SYS PRIME						
INCREASE RANGE	ATACMS ER	III	CUR CONT.	SYS PRIME						
INCREASE LETH.	ATACMS ATK PKG	I	HITECH MSL	SYS PRIME	TBD LATER					
IMPROVE SSKP	PATRIOT	III	CUR CONT.	SYS PRIME						

HORIZONTAL TECHNOLOGY INTEGRATION AND TECHNOLOGY INSERTIONS — SYSTEMS USED FOR THEATER MISSILE DEFENSE			
SYSTEM:	TPQ 37A FIREFINDER RADAR	ATACMS S-S MISSILE	PATRIOT S-A MISSILE
NUMBER:	XXX TBD	NONE—NEW BUILDS ONLY	ABOUT 2000
HORIZONTAL TECHNOLOGY INTEGRATIONS			
[NONE]			
TECHNOLOGY INSERTIONS			
MAJOR UPGRADES	•REDESIGN TO INCREASE RANGE OF DETECTION OF TBM	•MODIFIED DESIGN TO INCREASE RANGE OF ATTACK OF LAUCH SITES •NEW WARHEAD CAPABLE OFSEARCHING LARGE AREA TO FIND LAUNCH EQUIPMENT	•NEW OR MODIFIED FUSE TO IMPROVE SELECTION OF BEST POINT OF WARHEAD DETONATION •MODIFIED GUIDANCE AND CONTROL ELEC-TRONICS TO REDUCE MISS DISTANCES

MANAGEMENT IMPLICATIONS FOR FOUR PROGRAM TYPES				
	PROGRAM TYPE			
PRODUCT TO BE ACQUIRED:	NEW TECHNOLOGY I	BREAKTHROUGH ITEM II	EVOLUTIONARY ITEM III	OFF-THE-SHELF ITEM IV
CONTRACT IMPLICATIONS AND EMPHASIS	• FIXED PRICE • CLEAR OBJECTIVES • BEST EFFORTS • SCIENCE/ENG TALENT	• COST PLUS • PERFORMANCE INCENTIVE • VERY FLEX TERMS • TECHNICAL PROWESS	• TAILORED COST PLUS • SCHEDULE INCENTIVE • PAST PERFORMANCE	• FIXED PRICE • STRICT TERMS • COST DRIVEN
QUANTITY PRODUCTION		• FEW PROGRAMS • HI GAIN-HIGH RISK • BEYOND S-O-A	• MOST PROGS • OPN'L SPECS • PUSH S-O-A • SCHED DRIVEN	• FEW PROGS • NO TECH DEV. • STRICT SCHEDULE
PRODUCT AND PROCESS DEVELOPMENT		• PARALLEL DEVS. • EVENT DRIVEN • TECH IN HAND AT BEGIN FSD		
TECHNOLOGY DEVELOPMENT	• MANY PROJECTS • OPNL PAYOFF • BEYOND S-O-A			

THEATER MISSILE DEFENSE.

THEATER MISSILE DEFENSE.

Theater Missile Defense (TMD) systems initially were taken to include all of the items identified in Annex H of the Army Modernization Plan; i.e., the systems used to perform all four pillars of the approved Joint Theater Missile Defense Concept of Operations. Many of the items that contribute to TMD were not fielded primarily for that purpose. Using the criteria provided earlier, these systems were screened from further consideration in this section but may be found to be upgrade candidates in the section of this chapter where they are assessed in more detail.

Systems Considered.

The systems considered, together with the results of the winnowing, are shown in the above table. The strike-through indicates that the system was set aside as not a primary candidate for upgrade. The reasons for the set aside are also shown. None of the listed systems, for one reason or another, was found to be a candidate for horizontal technology integration based on its application to the TMD mission area only, but a few were found to be suited to technology insertions. In particular, note that the communication items used in TMD are discussed in the C3 mission area; and that intelligence systems are discussed in under IEW systems.

SYSTEMS USED IN THEATER MISSILE DEFENSE			
BM/ C3I SYSTEMS			
~~AUTOVON~~	1, 2	~~AUTODIN~~	1, 2
~~STRAT SATELLITES~~	1, 2	~~NATL ASSETS~~	1, 2
~~DSNET~~	1, 2	~~TAC SATELLITES~~	1, 2
~~ACUS~~	1, 2	~~CHS~~	2
~~TPN~~	????	~~MSE~~	2
~~IHFR~~	????	~~SINGGARS~~	2
~~ADDS~~	2	~~IEW NET~~	2
~~MCS~~	2	~~FAAD C2~~	2
~~CSSCS~~	2	~~TACFIRE~~	2
ATTACK SYSTEMS			
~~ATACMS BK 1~~	2	ATACMS-ER	7
FDDM	???	~~MLRS~~	2
FIREFINDER TPQ37A	8	~~ATTK HELOS~~	2
~~SPEC OPS~~	2	TENCAP	????
JSTARS/GSM	2	~~TR-2~~	1, 2
~~RIVET JOINT~~	1, 2	~~IGRV/GRCS~~	1, 2
~~UAV~~	1, 2	~~QUICK FIX~~	2
~~QUICK LOOK~~	2	~~TACJAM~~	2
~~TRAFFIC JAM~~	2	JTAGS	????
TRAFFIC WOLF	????	~~ADV HELO WPM~~	2
ACTIVE DEFENSE SYSTEMS			
~~THAAD~~	3	~~CORPSAM~~	6
PATRIOT	8	~~HAWK III~~	5
~~AVENGER~~	2	JTAGS	????
PATRIOT PAC 3	7 if select	ERINT	7 if select
PASSIVE DEFENSE MEANS			
~~SYSTEM OF MED/CHEM/BIO DEF.~~	2	~~MULTI SPEC. CAMOUFLAGE~~	
~~SMOKE~~	2	~~IRCM~~	2
~~DECOYS~~	5	~~SURV CP~~	2, 3
~~NBC COLL. PROT.~~	2	~~NBC UNIT DETECT, WARN.~~	2, 3
~~DSP SATELLITE~~	1, 2		

From the assessment above, it appears that technology insertion opportunities are mainly on the TPQ37 Firefinder radar, the ATACMS S-S missile, and the Patriot S-A missile.

Systems Discussion.

Theater Missile Defense is to be accomplished in joint operations involving the use of multi-service systems and national assets. The approved JTMD Concept of Operations includes four pillars: Attack Operations, Active Defense, Passive Defense, and Battle Management / Command, Control Communications, Intelligence (BM/C3I). The Army will not have all systems used to perform the functions required for conduct of Attack Operations, Active Defense, or BM/C3I. Most of the systems to be used in TMD operations were fielded for use in other roles. The THAAD missile and GBR radar, now in early development, are important exceptions.

Current Capabilities.

Current TMD capabilities leave much to be desired. The data produced by the several sensors of the BM/C3I systems, when fused and processed, has not demonstrated in operations much ability to locate theater missile launch complexes and sites of future launches. As a result, the capabilities for effective pre-launch strikes is low.

The sensors of the BM/C3I systems have demonstrated the ability to detect theater ballistic missile launches and quickly to pass warnings to active defense elements and to friendly forces in the vicinity of the expected impact point. Also, the processors with the sensors can backtrack to infer approximate launch point. Abilities to perform post-launch attack operations are limited somewhat by inaccurate determination of launch points but also by uncertain movements during the time from launch to arrival of strike assets—a time during which the empty launcher can move to concealment, or possibly cover.

The (non-nuclear) warheads of current air and missile strike systems have radii of effects too small to permit effective attacks, given the large accumulated uncertainties regarding the location of launchers. Moreover, the range of ATACMS—the only Army guided missile having capabilities even close to being adequate for the job—is too short to reach the potential launch points of many of the theater missiles.

The ability to perform active defense is essentially limited to the missile defense modified version of the Patriot aircraft defense system. This system, called Patriot PAC 2, is incapable of defending against the higher velocity theater missiles, and its coverage footprint against the threats that it can engage is well below the needs. Moreover, it has only modest lethality expectation when an intercept occurs, especially when the incoming missile carries multiple non-energetic submunitions. The overriding virtue of Patriot is that it, unlike all other active defense ATM systems, exists.

Passive defense systems are as they would have been had no theater missiles been present. Mostly they are limited to hasty cover in response to attack warnings from missile launch detectors.

Technologies.

To examine the opportunities for technology insertion in Army systems that would upgrade their capabilities to perform TMD functions, it may help to diagram the complex of systems used in TMD as shown in the table on the following page entitled "One Way to Think of TMD."

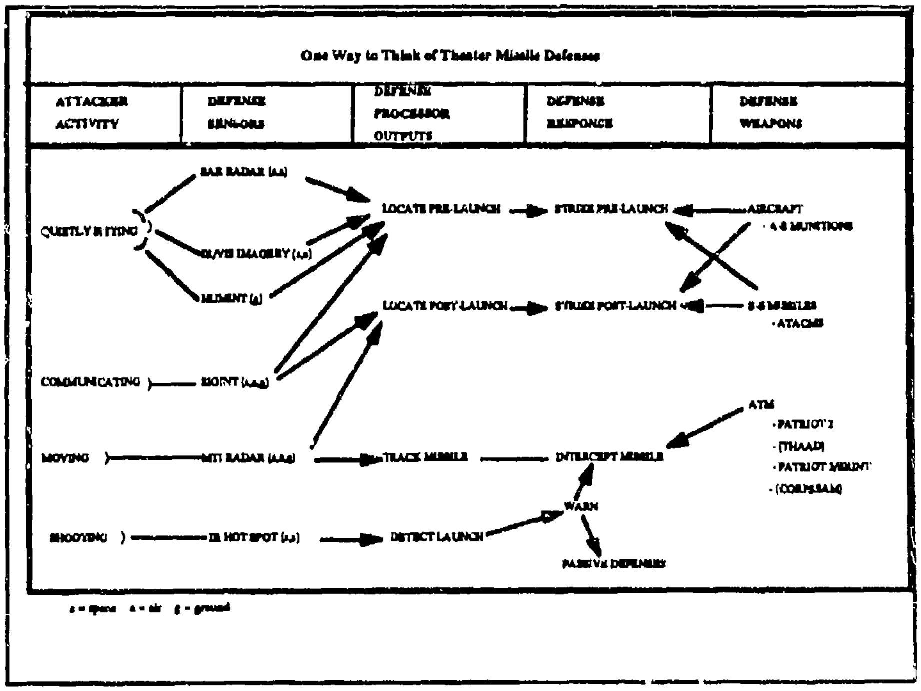
Several points are worth noting. The first is that the Army does not own or operate most of the BM/C3I sensors or associated processors and will not insert technology into them. On the other hand, it plans to have the GBR sensor that will be used to support THAAD and it already has the TPQ 37A MTI radar used by artillery units to infer (quite accurately) the location of firing enemy artillery batteries. The TPQ 37A could be upgraded to increase its detection range in the counter-missile role so that, given a suitable strike system, responsive counter-fire could be visited on more of the missile launch sites. The limit range of the upgraded TPQ37A would approximately match the maximum range that would be reachable by an extended range ATACMS. Of course, the range of GBR is planned to greatly exceed that of TPQ37A.

The Army does not own or operate the fixed-wing air systems used in attack operations and will not insert technology in them. These aircraft can reach all the launch sites and can carry large loads of

ordnance that can be precisely delivered if only the missile launch complex locations can be known accurately at the time of arrival of the strike. The Army may be able to contribute to joint strike operations by providing precise location of launch points for attack by air systems. It also can make its ATACMS S-S missile more useful for TMD Operations by increasing the range (e.g., trade off warhead weight for larger motor and increased velocity at burnout), and by improving its end-game lethality against targets not precisely located (e.g., by development of a large search area submunition warhead).

Patriot is the only Army missile having non-negligible capability to intercept incoming theater ballistic missiles and, as noted above, its capabilities are limited. The Army now is evaluating an upgraded version of a Patriot missile having several improvements to include a multi-mode seeker. The cost-benefits of this new version of Patriot are being compared to those of a candidate new missile called ERINT. It is too early to tell what the Army will conclude as regards to the competition between ERINT and multi-mode Patriot, but whichever the choice, there will remain in inventory a large number of the earlier Patriot PAC 2 missiles. Limited discussions with the industry developer indicate that it would be possible to improve their nominal SSKP of these Patriot PAC 2 missiles intercepting TBMs by something like 30% or so by improving the fuse and by modifications to guidance and control electronics. Incremental costs were unofficially indicated to range from as low as $30K up to $100K depending on whether the modifications are included in a new production missile or were retrofitted to a missile already in stock.

The latter case applies here. Whether the incremental gains warrant the considerable costs of Patriot PAC 2 missile upgrades is unclear, absent analysis in more depth than was here accomplished. It thus remains an interesting option whose overall justification remains somewhat unresolved.



Conclusions.

TMD operations are intrinsically joint in character. Army operations will need to be, especially in this area, closely coupled to those of the Air Force and the Navy, and to the operations of "national assets."

Current TMD capabilities are limited. Improvements are needed in the ability to locate launch sites for pre-launch attack operations, the ability to locate launch sites for post-launch attack operations, the ability to reach launch sites with S-S missiles, the ability of warheads delivered by surface-launched missiles to cover large areas of uncertainty of target elements, and the ability for lethal intercept of incoming missiles—altogether a rather long list.

Most systems used in TMD are not strong candidates for Army upgrade. Many of them are not owned or operated by the Army. Some (e.g., Hawk) are not fixable or being retired. Some are just starting development (e.g., THAAD, GBR) or not yet starting (e.g., CorpSAM) and need no upgrades at this time.

The big needs are for intelligence/target acquisition good enough to support attack operations, a missile that can reach and kill launchers, and an interceptor missile having good coverage footprints and good intercept lethality. The only radar that can be usefully improved is TPQ37A, the only Army S-S missile that can be improved to have much effect against theater missiles is ATACMS, and the only Army S-A missile system having any non-negligible capability to defend against theater missiles is Patriot.

Opportunities.

As shown in the Table below, there appears to be no opportunities for Horizontal Technology Integration and only a few interesting opportunities for technology insertion. They are:

- Upgrade the TPQ37A to enable it to detect and back plot incoming TBMs to provide more accurate launch point data to ATACMS and aircraft assigned to attack operations.
- Increase the range of ATACMS
- Provide a wide-area search brilliant submunition for ATACMS.
- Upgrade Patriot PAC 2 missiles—probably to something of less capability than PAC 3, most probably to include fusing/endgame to improve lethality.
- Though not horizontal technology insertion, continue to push for THAAD, GBR, and Corps SAM as the only ways to get an effective Active Defense.

TMD TECHNOLOGY INSERTION OPTIONS AND COSTS				
PACKAGE	RDTE M$*	UPC M$*	NBR SYSTEMS	TOTAL COST M$*
MOD-TPQ-37A	65	.55	35	84.25
ER ATACMS	140	1.25	1000	1,390.00
WASM ATACMS	300	.15	6000	1,200.00
TOTAL				2,834.25

*Notional Numbers

INTELLIGENCE/ELECTRONIC WARFARE.

Intelligence/Electronic Warfare (IEW) systems considered in this section support Theater, Corps, Division, and Brigade commanders by providing timely accurate intelligence and electronic warfare (EW) capabilities (jamming). The intelligence-gathering capabilities include signals intelligence (SIGINT) comprising communications intelligence (COMINT) and electronic intelligence (ELINT); imagery intelligence (IMINT) comprising photographic, electro-optic (EO/IR), and synthetic-aperture radar (SAR) imagery; and human-gathered intelligence (HUMINT).

Systems Considered.

The systems considered are those listed in Annex I of the Army Modernization Plan, and are listed in Table 2.2.10-1, with winnowing as described in paragraph 2.2.1 to remove from consideration systems which are unlikely to be candidates for horizontal upgrade. The systems cannot be conveniently grouped by function because of past and planned merging of functions, e.g. jammers combined with SIGINT or SIGINT combined with IMINT in the same system.

by function because of past and planned merging of functions, e.g. jammers combined with SIGINT or SIGINT combined with IMINT in the same system.

Systems Discussion.

The overall IEW system comprises the Theater, Corps, Division, and Brigade IEW Systems; in addition, both national and allied or coalition intelligence assets are to be exploited in support of the Army's mission. The functions supported are Indications and Warning (I&W), Intelligence Preparation of the Battlefield (IPB), Protection, Situation Development, Targeting and Target Development, and Battlefield Damage Assessment (BDA).

IEW system is almost self-contained; however, data produced by national collection and analysis assets enters via the Tactical Exploitation of National Capabilities (TENCAP) program; in addition, data from allied/coalition sources must be supplied by means not completely definable until the cooperating forces are identified.

Current Capabilities.

The SIGINT/EW system comprises airborne and ground-based collection assets, as well as analysis and distribution equipment. Many of the systems employ single-function sensors/processors on individual platforms which cannot keep pace with modernized equipment. The multiplicity of ground vehicles and airborne platforms, as well as high demands on manpower, result in high O&S costs. Large trailers and shelters impair mobility. Much of the equipment is 15 to 25 years old, and reaching the end of useful life.

SYSTEMS USED IN INTELLIGENCE/ELECTRONIC WARFARE				
TRAILBLAZER	[6]	Ground-based CS	Modular CS	[3]
TRAFFICJAM	[6]			
TEAMMATE	[6]			
TACJAM	[6]			
TEAMPACK	[6]			
QUTS	[6]	TRACKWOLF/E		
		ARL		
GUARDRAIL	[6]	GUARDRAIL CS	ACS-C	[3]
CRAZYHORSE	[6]			
QUICKLOOK	[6]			
MOHAWK	[6]	JSTARS GSM	JSTARS CGS	
QUICKFIX	[6]	Adv. QUICKFIX		
		UAV-SR, UAV-C		
GSR	[6]	LBSS [3]	MMSS	[3]
ICTT&TCT		EPDS/ETUT		
GST		THMT/MITT/FAST-1		
TROJAN SPIRIT		ASAS		
TCAC				
MICROFIX				
FAISS				
HAWKEYE				

IMINT support of the battlefield is presently deficient. We have inadequate capabilities for providing national-level intelligence products to divisions; the TENCAP program is currently supported with only five Tactical High Mobility Terminals. There is no organic capability at Corps or below for imagery collection forward of the FLOT. The Mohawk is getting old, but the JSTARS prototype demonstrated spectacular MTI/SAR radar imagery during ODS.

There is currently no battlefield system for fusion and distribution of intelligence. ASAS has been in development for more than a decade, but even limited performance will not be available until mid-decade. The Hawkeye system, produced as an interim measure to ASAS, provides access to intelligence data but requires manual fusion.

The Modernization Plan indicates that programmed procurements should result in "green" status for all required IEW capabilities. Of course, this assessment does not consider that the planned procurements might not occur because of possible drastic budget cuts during the present administration. There is also

missions. Never the less, we can consider the systems listed previously as possibly requiring upgrades, at least by the end of the decade/century/millennium.

The Ground Based Common Sensor provides SIGINT and EW capabilities out to approximately 30 km. This equipment, which presently would be used in contingency operations, is bulky. Consideration should be given to replacing the SIGINT function via Common Ground Station, and exploiting other EW assets, e.g., Advanced QUICKLOOK.

Technologies.

Technologies likely to be candidates for horizontal insertion in IEW systems are listed below.

- UAV technology was greatly advanced in the last decade by developmental efforts (non-US.) resulting in effective systems, as well as research funded by DARPA on high-performance UAVs. Current Army plans include two versions of UAV for FOFLOT operations. There is some question as to the need for both "close" and "short-range" UAVs. Might not the close mission be handled with the short-range UAV? While the short-range UAVs themselves are more expensive than the close UAVs, it would be more cost effective to buy only one system and more UAVs. This avoids two procurements and the different O&S equipment. An important issue in this alternative would be ensuring that the corps commander does not take all the UAVs as his own. In any case, UAVs require POSNAV and are candidates for HTI of GPS.

- Advanced infrared and visible optical imaging components offer advantages for operations at night, or under low-light-level conditions. These sensors traditionally have been developed under several technology areas independently. Since UAV and other IEW systems providing imagery are likely to employ IR/EO sensors, this is a likely area for horizontal insertion of 2nd generation FLIR.

- SIGINT processing techniques have been developed for Modern Modulations, which will emerge in the next decade. Some Modern Modulations capability is planned for Advanced QUICKFIX. This technology is probably of interest only for SIGINT systems, but it should be considered for GUARDRAIL insertion.

Conclusions.

UAV technology offers a high payoff for surveillance and target acquisition under direct control of combat commanders. These systems will be very important, and are serious candidates for future upgrades. The use of optical imagery, both IR and EO, for UAV surveillance should exploit the optical components developed under funding for other systems. Thus, the UAV is a candidate for HTI of GPS and 2nd generation FLIR.

The question remains as to the need for both "close" and "short-range" UAVs; it should be more cost effective to buy only the short-range system with more UAVs to avoid two procurements and the different O&S equipment.

Modern Modulations processing capability should be enhanced and extended to GUARDRAIL as corresponding threat systems appear.

Processing capabilities for IEW systems should continue to exploit commercial computers and networking and the trend toward merging IEW functions within terminals or ground stations should be encouraged in order to exploit the advantages of a truly open architecture.

The function of GBCS should be provided by other, more-attractive systems.

LOGISTICS.

Logistics provides not only the distribution of supplies on the battlefield, but the production of those supplies as well as the planning, positioning, etc. required to make them available when and where needed. While the logistics BFA could benefit from horizontal technology insertion in the areas of communications, computers and navigation, the logistics system could also benefit from insertion of industrial technology used for planning and management of resources. In addition, tremendous cost-savings are possible by changing how procurements are done.

Systems Discussion.

Unlike the other BFAs, which are essentially self-contained within a theater of operations, the logistics function is fundamentally dependent upon CONUS-based band pre-positioned supplies, and the various means for delivering those supplies. Tactical logistics is the essence of the logistics BFA as it relates to field operations; strategic logistics addresses the need to produce, stockpile, pre-position, and deliver all material and supplies required for any Army missions; operational logistics comprises those systems and functions required to connect tactical logistics operations to the strategic sources of supply.

Strategic Logistics.

Strategic logistics begins with the procurement of supplies and materials by the Army Materiel Command and the Defense Logistics Agency. Materials are stockpiled, both within CONUS and pre-positioned to support force projection, to support operations without depending upon production sources in the short term. For supply from strategic sources there are required systems for mass transport via railcars, sealift, and airlift; in addition, over-the-shore and airlift capabilities for delivery of materials are critical for delivery within the theater of operations, as is distribution of petroleum.

Operational Logistics.

Operational logistics takes up the job at points of concentration where supplies and materials are delivered by the strategic logistics system, and provides the intermediate level of distribution to get them to the fighting units, which are the entry point to the tactical logistics system. Besides the physical delivery capabilities, e.g. petroleum pipelines and trucks, a critical function is management of information for locating supplies, predicting required volumes of various items, tracking requests and supplies throughout the process. Many of the functions/systems which begin at the operation-logistics level merge naturally into the tactical-logistics system.

Tactical Logistics.

Tactical logistics comprises a variety of systems and equipment for distributing supplies to the fighting forces, and for providing a variety of support services. A wheeled fleet provides secondary distribution and material handling equipment off-loads supplies for final delivery. Power generation capabilities are required for many tactical systems, and maintenance and calibration equipment must be available for these systems as well. Services to maintain the fighting ability and morale of troops include medical facilities, field kitchens, shelters, etc. Information-management systems are required to coordinate the flow of supplies to the combat units.

Current Capabilities.

While the logistics capabilities of the Army are impressive as viewed from the success of ODS, underlying problems would have been revealed if the war had lasted only half again as long. The deficiencies of the current system begin at the top, with the procurement system, which suffers from the malady of rigid but defensive interpretation of regulations which actually do support more effective contracting. In the actual distribution of supplies, systems suffer from a variety of deficiencies at strategic, operational, and tactical levels. This state of affairs is, in many cases, a natural result of under-emphasis in funding of logistics-related systems because of an understandable preference for identifiable war-fighting capabilities. The scale of logistics operations combined with the range of systems required

emphasis in funding of logistics-related systems because of an understandable preference for identifiable war-fighting capabilities. The scale of logistics operations combined with the range of systems required to address the various logistics missions make a system-by-system evaluation of capabilities unrealistic for this discussion; instead, the discussion will focus on areas of functionality in assessing capabilities and making recommendations.

At the source of supplies and materials, the procurement system suffers from inefficiency and unresponsiveness. Examples abound of price inflation due to excessive or irrelevant specifications, requirements for unnecessary inspections, and small-lot ordering. Considering the volume of commodity purchases, the Army could recover a portion of the buying power it has lost or will lose due to budget cutting by becoming more efficient in its buying practices.
The need for world-wide transport demands improvements in rail, sealift, and airlift capabilities; however, the Army does not like buying railcars any more than Air Force likes buying transport aircraft or the Navy likes buying transport ships. As a result, the present capabilities for global transport are seriously limited in terms of both tonnage capacity and speed of response. Over-the-shore and air-drop delivery of supplies are limited by the performance of current systems; for example, current over-the-shore delivery is limited to relatively benign sea conditions.

Logistics vehicles cannot move over all terrain, and therefore cannot operate in areas often of most interest in battle. While logistics vehicles have used, and will increase the use of, GPS for navigation over long distances, these transport vehicles <u>do not have radios</u>. Thus, when plans go wrong, these vehicles must be met by combat troops and redirected to the new coordination point.

Perhaps the most glaring shortfall of the existing logistics system is the inability to plan for, coordinate delivery of, and locate supplies, starting at CONUS depot points and working down to combat units dispersed over an extended theater of operations, and locating specific items when they are needed is difficult.

<u>Technologies</u>.

- The use of GPS for guiding logistics vehicles in long-range resupply operations in ODS makes obvious the utility of this technology.
- Advanced communications capabilities should be provided, also in support of long-range resupply; although HF radio may be useful for this purpose, satellite communications would offer better reliability and survivability.
- Current computer technology and industry-standard software could meet many of the needs for managing logistics information.
- NDI systems and software should be available for logistics functions, e.g. shipping-container management, FEDEX, etc.

<u>Conclusions</u>.

The critical issue is the determination of which logistics capabilities are critical to future tactical operations. In the past, logistics failures have been revealed only on the battlefield. The Army's initiative in DIS provides a new capability for evaluating logistics requirements and the consequences of logistics deficiencies.

AVIATION:

Overview.

Army Aviation strategy for the continued modernization of the fleet is in basic alignment with the current DoD guidance and is commendable.

(a.) There is only one major new start seen in the next 10-15 years (Comanche).
(b.) The remainder of the modernization program consists of improving existing fleets by technology upgrade.
(c.) The Aspin "silver bullet" smart munitions issue is addressed by the Hellfire Fire and Forget missile. A smaller missile capable of acquiring and defeating helicopters in clutter is being considered by the Army and Marine Corps.
(d.) There is a visionary program of technology research and development to provide for future aviation capabilities.
(e.) Finally, a recent reorganization of the aviation force structure provides for the removal of 3500 older aircraft from the fleet (UH-1, OH-58A/C, and AH-1) by the year 2000. Because of the decreased resources in Army investment accounts, this Army Aviation modernization strategy will be difficult, if not impossible, to execute.

Our panel believes that these programs are worthy of the resources required to execute them, and the Army should make every effort to procure from DoD the necessary funds to execute this strategy. Understanding that resources are inadequate to execute the existing program, the following observations are offered in the spirit of looking at the potential for further Horizontal Technology Integration and Vertical Technology Insertion opportunities that would appear to be significant, cost effective applications, especially in the critical area of "digitization". Some considerations for program cost reductions are also offered, knowing full well that these will be difficult and unpleasant reallocations of funds that are not improperly allocated today, but may yield greater marginal utility when applied to other portions of the Aviation strategy, or may be necessary to fit within an inadequate funding level.

Apache: The Army POM currently funds the upgrade of the AH-64 fleet of 584 aircraft to C model configuration (without the Longbow Radar), and 227 additional aircraft to a D model (C plus the radar). If there is a war in the next 10-15 years; and historically the probabilities are high, the Apache fleet will be a mainstay of the Army's response. This upgrade permits the Army's basic attack helicopter fleet to be effective throughout the end of this century and probably a decade into the next. The incorporation of the Longbow Radar and fire control system onto 227 helicopters provides the Army with a significantly upgraded capability which when added to the Hellfire Fire and Forget missile, will allow the force to operate in more limited weather conditions and obscurants with increased lethality and greater survivability. The D models also incorporate an engine upgrade to provide additional power for the bleed air operation of the Environmental Control System (replacing a major source of system unreliability in the shaft driven compressor). All the fleet receives increased electrical power, enhanced fault detection, improved cooling, digital communications, navigational upgrade, and significantly increased processing power, so that the radar and fire control LRUs can be used on any aircraft. This common base configuration permits the Apaches to fight in a mixed team (e.g., 1-D with 2-Cs). The Fire and Forget Hellfires can be launched, either from the radar acquisition, only on the D Model, or from the FLIR acquisition on either the C or D model. The D model can sweep the area with the Longbow radar and digitally hand off the sectors of enemy targets to his C model wingmen. They, in turn, can point their Target Acquisition and Detection System (TADS) accurately to the indicated targets, acquire them with their FLIR and pass the target to the Fire and Forget Missile, or attack the target with more traditional Semi-Active Laser (SAL) missile. The current lack of a plan to equip the Apache fleet with a second generation FLIR is a serious tactical shortcoming and should be corrected as a matter of very high priority. The opportunity of inserting the Comanche 2nd generation FLIR into the Apache seems to be a classic opportunity for Horizontal Technology Integration. There is also an opportunity to install a digital map in the Apache display system. Given the Apache proclivity for operating at tree top height, the benefits of the digital map

base seem both significant and obvious. Serious consideration should also be given to the HTI of a digital map display into the upgraded Apache fleet. The elusive goal of adding capability while reducing operating costs is apparently within grasp in the Apache upgrade program. The cost per flying hour of a C model is expected to be 10 percent less than the current cost of the AH-64A. The addition of the radar system on the D model brings the cost per flying hour to an attractive figure approximately four percent (4%) above the current A model.

Comanche: The Comanche program is funded (mostly) through DEMVAL. Given the Apache upgrade and the demand on Army investment accounts, there are two arguments the Army must successfully make to secure and retain funds for the RAH-66 Comanche helicopter. First, they must persuade themselves, OSD, and the Congress that the benefits of the Comanche program warrant the investment, when compared to all other helicopter alternatives for the Army. Second, the Army should attempt to persuade OSD and the Congress that the Comanche program warrants the investment, given all other aircraft modernization alternatives, even across the other services. The first argument is easily made. All other helicopter alternatives to the Comanche have been exhaustively examined.

a) The thought of retaining the aging fleet of Cobra gun ships and OH-58 A/C models and paying significant dollars in maintenance and readiness training of systems and crews should be unacceptable. These systems Should not be taken into combat: the young American soldiers who crew and maintain these systems deserve much better than this obsolete technology.

b) The idea of purchasing new AH-64s and OH/AH-58Ds is far less attractive from a cost-effectiveness standpoint than procuring the RAH-66.

c) The search for an offshore system that is less costly and/or more capable than the Comanche has not produced a candidate.

Therefore, if the DoD is committed to the national requirement of executing two Major Regional Contingencies under "near simultaneous" timelines and accepts that we should not put our soldiers into combat with Cobras and OH-58A/Cs, then the requirement for the Comanche is uncontested. The preference for funding Comanche over some other aircraft is principally configured for ground support, which is the second argument, is more sensitive due to the interservice issues, but no less compelling. The USMC plan to upgrade their AV-8 aircraft, which support three Marine Expeditionary Forces (Divisions), at a cost that appears to be almost double the per aircraft cost of a new Comanche. There are no serious AF ground support upgrades with the demise of the A-16 program and an absence of funding for a night/adverse weather capability for the A-10 (Navy?).

While the panel supports the current Comanche program, we believe there are acceptable configurations that are less expensive and less capable, which are preferable to the loss of the program. The Comanche, less Longbow, would clearly be preferred to a loss of the program. The Longbow radar could easily be delayed, and made an add-on to subsequent blocks of Comanche production. The Comanche Longbow radar could also be considered as a product improved radar to be fitted onto the Apache C or D models. Longbow, when required in adverse weather, could be tactically provided by adding Apaches to a Comanche team. The cost savings of delaying the Longbow program, if necessary to retain the basic Comanche program, could be taken. The second cost saving, which also embodies some decrease in performance, could possibly be made in the modest reduction of some of the stealth requirements. While the panel has not had the time to look at this thoroughly, there are opportunities to review what is "required" and what is "desired" in term of signature while operating at and above the nap of the earth. There may also be some cost savings possible in making the basic Comanche to one level of stealth, then adding a kit improvement to a greater level for use on special missions. The cost trade-off opportunities of the stealth design, if required to save money, is a potential source of program funds, but it requires greater investigation than the panel could give it.

While the Comanche, by virtue of being a new system, is not a candidate for HTI or VTI, the issue of the potential of using Comanche technology for insertion into other airframes was considered. In

general, it is not feasible to take Comanche mission equipment package (situational awareness and image fusion capabilities) and integrate them into Apache or Kiowa without redesigning the entire architecture to provide high speed data buses and fiber optic capabilities, etc. These massive changes argue instead that it is more cost effective to procure the Comanche. There are obvious opportunities for portions of the second generation FLIR of the Comanche to be used in the Apache and for more common use of the digital map display components of the Comanche in other aircraft.

From an operational standpoint, the panel encourages the Army to be more descriptive of the benefits of using Comanches in the early entry phase of the DoD two MRC scenario. The image of having Comanches on the scene when a forced entry operation begins at night, and having them supported (refueled/rearmed) by CH-47s, or perhaps USMC V-22s, that are bringing fuel and ammo from off-shore vessels or friendly airbases in the region is not well appreciated by many who will be holding the DoD purse strings. The capability of Comanches, as the centerpiece of the extended anti-armor capability for early entry, light forces, should be understood clearly, so that the B-2 bomber with conventional (JDAM/JSOW) munitions is not seen as the only national means of stopping the enemy invasion before we can build up enough combat capability on the ground to win a decisive victory. More creative enthusiasm is urged in describing the contribution of Comanches in this scenario.

Digitization: In keeping with a primary recommendation of this study that Digitization is the principal capability to be achieved by the Army in HTI, the importance of Army Aviation being integrated into the overall Army program cannot be overstated. The need for shared situational awareness between the ground forces, their supporting Army Aviation forces, and other joint forces (JSTARS, AWACS, etc.) is central to synchronized command, accurate fires, and decisive maneuver without fratricide. Proliferation of GPS within our Inertial Navigational Systems, miniaturized to reduce space, weight, and power requirements contributes heavily to situation awareness. Use of the Improved Data Modem (IDM) throughout the aviation fleet provides compatibility between tri-service aviation communications data links. The corresponding requirement for the IDM/IVIS contention issues to be resolved to allow our own aviation and ground forces to communicate with each other is one of the major obstacles to our land force digitization. The Enhanced Communication Interface Terminal (ECIT) integrates the Commanders' airborne radio console functions, plus adds new capabilities with imbedded IDM/GPS/imagery and connectivity to the 1553 data bus, while decreasing the space, weight, and power requirements by almost an order of magnitude. The Aviation Mission Planning System (AMPS) and improved tactical radios (AN/ARC-220 improved HF and AN/ARC-164 Have Quick) complete the list of capabilities that must be widely distributed throughout the aviation force in order to be digitally compatible with the ground units. Current POM funding for the programs is significantly lacking even for Force Package I. There is no recognized requirement to provide this capability to all those land forces with supporting aviation units beyond Force Package I who would be required to execute the DoD scenario of two MRC in "near-simultaneous" timeframes. This includes virtually all of the active component.

Cargo Needs--SLEP,V-22, Commercial, new start Aerial Cargo Transport (ACT)

Blackhawk Fleet--

Retention of OH-58D

Reduction of Obsolescent A/C

SEMA--

SOLDIER SYSTEM/WARFIGHTING CONCEPTS.

Overview.

As the centerpiece of a smaller, more lethal, and more projectable Army, our soldiers require modernized weapons, clothing, and equipment to survive the many environments, terrains and levels of military threat they will encounter. Our basic technical strategy of modernization is to draw upon advances achieved by the Army, other services, allies, academia, and industry, and integrate state of the art

technologies to improve the combat effectiveness of the individual soldier. The concepts of the Soldier System provide the strategies needed to ensure linkage to the Army's modernization objectives.

The Soldier System.

The "philosophy" of the Soldier System evolved only a few years ago, but the promise of its precepts quickly garnered wide-spread interest and support. Its premises are the bedrock of this thrust and merit explanation and definition.

Background.

While the multitude, quality, and diversity of individual weapons, clothing, equipment, and rations provided to combat soldier are testimony to his importance, they paradoxically often work to the soldier's disadvantage. Through the years, many agencies have been involved in the design, funding, development, prioritization and fielding of such items; they have created a plethora of diverse items. There has been no centralized, integrated focus on the interrelationships of soldier items. Thus, unwittingly, we have overloaded the soldier, provided some incompatible equipment, and produced a loss of efficiency. In sum, we imposed negative effects on the combat effectiveness of the Army's most valuable resource--the soldier.

Soldier System Program.

We recently recognized the need to "manage the soldier" in a manner befitting his importance as the ultimate battlefield system. We instituted a program that will permit the combat potential of each soldier to be fully realized. We began by defining and formalizing a concept. This was by the Soldier as a System Program (SAAS). We then established a management structure for the Soldier System.

Organizational Structure.

The Army established two agencies whose sole mission is to focus on the soldier: TRADOC Systems Manager-Soldier (TSM-S) and Project Manager-Soldier (PM-SDR). The TSM-S and the PM-SDR form an aggressive, integrated, centralized management team responsible for modernizing and maximizing the soldier's warfighting capabilities. These agencies are complemented by a Soldier Systems Integrator at HQDA.

Soldier System Implications.

The terms "Soldier as a System" and "Soldier System" do not mean or imply in any way that we perceive soldiers in impersonal terms; they are not machine-like. Rather, in establishing the "Soldier System," the Army now gives the visibility and management to soldier programs that major weapons systems have enjoyed for years. Major weapons systems are characterized by integrated, centralized management and funding. We want to do the same for the individual soldier; indeed, we must and will.

Three categories of definitions are central to the Soldier System:

- Core Definition. The Soldier System is "all that the soldier carries, wears, or consumes in a tactical environment." A key word is "tactical." Soldier System items are those for, and used by, individuals in combat environments (equipment/clothing/ such as dress uniforms, A rations, etc., are not part of The Soldier System).

- Capabilities Definitions. The Soldier System recognizes and defines five significant capabilities needed by every soldier. the goal of soldier modernization is to enhance these capabilities; each clearly dovetails with out larger Army modernization objectives. The capability definitions follow; the italics mirror the Army's modernization objectives.

  - Lethality - the soldier's ability to defeat threat soldiers and their equipment. *The soldier dominates the maneuver battle.*

- Command and Control - the soldier's ability to direct, coordinate, and control personnel, weapons, equipment, information, and procedures necessary to *win the information war*.

- Survivability - the soldier's ability to protect himself against threat weapons effects and environmental conditions. *This capability aligns with protecting the force and minimizing casualties*.

- Sustainment - the soldier's ability to maintain himself in a tactical environment. *This capability also aligns with protecting the force and minimizing casualties*.

- Mobility - the soldier's ability to deploy to and move about battlefields to fulfill his assigned missions. This capability parallels *projecting the force* into/ around the battlefield.

• Soldier Category Definitions: The Soldier System recognizes three categories of soldiers: the dismounted soldier; the crew soldier (air and ground); and, all other soldiers. A key clarification here is that the dismounted soldier category is not restricted to infantry soldiers. Dismounted refers to soldiers who "walk to war," and this designation crosses a number of military occupational specialties.

Supportive/Adjective Soldier System Programs and Policies.

Proceeding from the Soldier System baseline, a number of specific policies/programs have been or will be instituted to support soldier modernization:

• Integrating the Soldier System into the Concept Based Requirement System (CBRS), Battle Labs, and Louisiana Maneuvers. These processes are used by TRADOC to identify and prioritize requirements. It is important that future systems relevant to the soldier be identified and elevated as solution components.

• Establishing a feedback program from the field. This consists of frequent correspondence with field commanders and command sergeants major, presentations at pre-command courses and sergeants major courses, surveys of soldiers and leaders at units and at courses, and visits and conversations with soldiers and leaders at different levels. Deficiencies and recommendations are acted on immediately by combat developers who use the CBRS. The process is completed by providing feedback to the soldier.

• Employing a "Package" Fielding Concept. In the future, related items that must be integrated to meet a required level of capability will be developed and fielded as a system or "package." Such items will be funded, developed, tested, and supported as integrated entities to improve mission capability. Support items not included in the packages will be developed and fielded in tandem. For the most part, modernization items will be centrally funded and fielded.

• Improving the quality of life of soldiers in tactical environments. This strategy addresses support systems that enhance the quality of life of soldiers in the tactical environment. When a support system directly impacts on the modernization process of the Soldier System, e.g. Force Provider, it should be considered a high priority program, and executed in parallel with Soldier System items. Force Provider is a soldier support complex which provides soldiers a brief respite from the rigors of the battlefield. It offers billeting, hygiene, and food facilities.

Land Warrior

The Land Warrior will be an integrated system composed of modular subsystems which will synergistically improve soldier capabilities in the five areas mentioned above. Operational capabilities and requirements of the warfighter will be linked to technology insertions for a modular concept. This will provide the warfighter the means to overmatch the enemy with relatively low risk and high payoff capabilities as they become available.

(1) Lethality: The lethality capabilities will enable the soldier to see better, locate the enemy, and kill the target under all visibility conditions. The LAND WARRIOR will provide the soldier a vision enhancement capability that will accurately and effectively detect, classify, recognize, locate, and identify hard and soft targets during day, night, and periods of limited visibility beyond the range of the weapon being used. It will overcome many of the Manpower and Personnel Integration (MANPRINT) problems associated with current weapons and sights. The LAND WARRIOR will not degrade manual control of any weapon system.

(2) C2: The system's C2 enhancements will enable the soldier to have secure voice communications; create, send, receive, and store information; display visual images to include digital maps and graphics; and transmit and receive position location information and calls for fire. The system will facilitate target hand-off and fire distribution. Individual components should maximize hands-free operations and have the capability to filter excess information. The LAND WARRIOR must facilitate mission planning and execution while maintaining unit cohesion over extended distances. The C2 enhancements must link with the digitized battlefield capability of mounted, aviation, and dismounted forces.

(3) Survivability: Improvements in lethality, C2, mobility, and sustainment will implicitly enhance soldier survivability. The LAND WARRIOR should provide maximum protection, within the state of technology and within the soldier's load limits, from small arms direct fire; antipersonnel mines, flame and incendiary weapons; effects of nuclear, biological, chemical (NBC) weapons and directed-energy warfare; and fragments and flechettes resulting from indirect fires. The LAND WARRIOR should incorporate hearing protection and prevent, disrupt, or deceive the threat's target detection/acquisition capability. Multi-threat warning devices will be provided within the capabilities of existing technology. The survivability subsystem should impose less degradation of essential combat tasks than current protective equipment, including less degradation of the soldier's senses, particularly peripheral vision, aural, and touch. Additionally, the system should not create a significantly larger signature of the solder than already exists.

(4) Mobility: The LAND WARRIOR should result in a greater reduction of the soldier's load over like capabilities which currently exist. The LAND WARRIOR must be compatible with the requirements for mobility of all types of dismounted soldiers: airborne, air assault, mechanized, light, ranger, and special operations forces. This requirement is inclusive of all environmental conditions and all natural or man-made obstacles. Vision enhancements are required which will substantially increase the soldier's mobility capability at night or during periods of limited visibility.

(5) Sustainment: Sustainment capabilities must support the protected soldier continuously for longer durations than currently exist. Resupply includes portable power, maintenance support, food, water, and munitions.

This integrated, modular approach allows the Army to tailor configurations for soldiers based on their unit missions and locations on the battlefield. Modularity allows commanders and soldiers the choice of carrying and using only those components necessary to execute their assigned missions. The flexibility of this modular approach is essential for success in conflict and crisis. LAND WARRIOR is fully adaptable to any environment; it responds to and supports the commander's mission, enemy, troops, terrain, and time (METT-T) analysis.

Current Program Assessment.

Here we present the full range of research, development, and acquisition programs for the individual soldier. They represent a progressive approach, with solutions in store for the near-, mid-, and far-term. The near- and mid-term objectives are achieved through curent technologies; far-term improvements depend on futuristic/breakthrough technologies. The chief modernization objective is to improve the individual combat soldier's combat effectiveness by providing an integreated, modular system that

enhances the soldier's warfighting capabilities, and is METT-T tailorable. The program that exemplifies this objective is Land Warrior.

This section overviews the modernization process, then breaks out the programs by Soldier System categories: dismounted combat soldiers' combat crew soldiers (ground and air); and, all other soldiers.

In the discussions of the combat crew soldiers, and the "all other soldiers" categories, **only those programs and deficiencies that are unique to each type of soldier are addressed.** Deficiencies and programs that have commonalty across soldier groups are discussed in the dismounted category.

These modernization programs are applicable to Special Operations Forces (SOF) when commonalties exist; but programs unique to SOF are excluded.

The discussion of programs for each of the three soldier categories includes a chart showing the program's time frames and funded/not funded status. Also, a matrix for each category reveals the potential to achieve our modernization objectives; the matrix uses a Red, Amber, Green rating scheme:

Red (R) = No capability exists to achieve objective, or it is severely limited.

Amber (A) = A limited capability exists to achieve objective.

Green (G) = Adequate capability exists.

Assessments of our modernization efforts in each category are based generally on RD&A status of technologies/systems in relation to progress toward our long-range objectives. An assessment summary based on overall funding issues for soldier modernization is at the end of this section.

Modernization Overview.

Before describing the specific programs in each soldier category, here is an overview of modernization solutions and initiatives.

In the near term, we improve the combat capabilities of soldiers by fielding such items as the M4 Carbine, laser/ballistic eye protection, cold/wet weather gloves and boots, individual load bearing vests, and improved rations. We move toward added capabilities, in the mid-term, via The Soldier Enhancement Program (SEP). SEP is a Congressionally directed and funded RDT&E program, instituted in FY90, to improve weapons and equipment for the combat soldier. The main purpose of SEP is to develop, obtain, test, and field items of equipment (preferably off-the-shelf items) in the near-term that pass the "common sense test" of experienced soldiers. It provides, and will continue to provide, a quick response mechanism to meet urgent soldier needs by accelerating development and fielding selected items. The intent is to increase the soldier's combat effectiveness via improved personal equipment, weapons with greater lethality, and further improvements in weight reduction, durability, reliability, survivability, ease-of-use, communications and navigational aids.

In the mid-term, soldier will receive new or improved thermal weapon sights, day optics (for the M16 rifle, M249 SAW, and M4 Carbine), a lightweight hand grenade, multi-threat body armor, advanced battledress overgarment, and protective mask drinking system.

In the far-term, the soldier will receive LAND WARRIOR, which is currently defined in a mission need statement.

- Advanced Technology Demonstrations (ATDs), beginning with the Soldier Integrated Protective Ensemble (SIPE) in FY93, will help us to determine the final configurations of LAND WARRIOR and will be the basis for the requirements document. SIPE is an ongoing science and technology program that exemplifies our soldier modernization strategy and integrated Soldier System approach to improve combat effectiveness. SIPE will exploit the most promising high payoff technologies

and engineer a modular head-to-toe fighting system, providing the soldier with enhanced lethality, survivability, and sustainability against multiple battlefield threats. Although the thrust of this effort aims at the ground soldier, its diverse technologies will have applications for all soldiers.

Visual and Aural Enhancements.

Improvements for day and night vision devices meet required capabilities out to the mid-term. Research and development are moving toward meeting far-term capabilities. Aural enhancement developments will not be realized until mid- to far-term. Science and Technology efforts to develop a basic information management system will be demonstrated in the mid-term. Full scale development of a totally integrated information management system will be needed to meet our far-term capabilities.

Requirements.

The materiel solutions are listed in the following figure and reflect funded or unfunded (i.e. does/does not) requirements in RDT&E and/or procurement.

DISMOUNTED COMBAT SOLDIER

NEAR FY 94-95	MID FY 96-99	FAR FY 00-08
DOES	***DOES***	***DOES***
LETHALITY	LETHALITY	LETHALITY
M16A2	Thermal Wpns Signt AN/PAS-13	Objective Ind Cbt Wpn
M11 9mm Pistol	M4A1 Carbine w/Day Optic	Objective Per Def Wpn
PAAG-4A IR Aiming Lt	M16A3	AN/PAS-XX
M249 Light Weight Tripod*	M16A3 Alternate Iron Site*	Adv Integrated Manportable Sys
M249 SAW Collapsible Butt Stock*	Light Weight Hand Grenade	Heads-Up Display (HUD)
AT4 Night Vision Bracket*	5.56 NATO AP Round*	Vision Enhance Image Intensifi-
Alt Color Trqacer Rd*	M16/M4 Modular Wpn System*	cation Thermal
M4 Carbine	M249 SAW w/Day Optic	COMMAND & CONTROL
M249 Assault Pack*	Individual Carried Records	Ident Friend/Foe
M24 SWS Night Fighting Cap*	SURVIVABILITY	***DOES NOT***
M24 SWS Imp Spotting Scope*	Adv SWD Goggles	LETHALITY
M24 SWS Imp Optic Rail	Multi-Threat Body Armor	Full Solution Fire Cntrl
M203 Grenade Launcher M4	M40 Protective Mask P3I	SURVIVABILITY
Portable Periscope*	Lightweight CB Protective Garment*	Protect Fr White/Red Phosphorus
Mini Binocular*	Light Weight CB Prot Glove*	Improved Protection
SURVIVABILITY	Ghillie Suit	Multi Threat Warning Device
M24 SWS Laser Projection*	SUSTAINMENT	.9 Chance of No Perforation/Shock
Laser/Ballistic (BLEPS)	ECWCS P3I	Damage
M40 Protective Mask	Multi Purpose Over Boots	Integrated Flotation Sys
Water Ind Purification System*	Long Range Ration Patrol Improved	Emhanced Camo
Soldier Fighting Cover	Shelter Half Improvements*	SUSTAINMENT
Imp PASGT Helmet Suspension*	MOBILITY	Micro-Climate Conditioning System
Lightweight PASGT Helmet	40mm Grenade Vest	Reduce Heat Stress
PASGT Vest	Tac Assault Personnel Parachute	Semipermeable Membrane Sys for
CAPS	Parachutist's Ind Equip Rapid Release	CPU
SUSTAINMENT		Waste Elimination System
Lightweight Rain Suit*		Improvements to Rations
M24 SWS Flash Suppressor/Blast		Packaged Water
Attenuator*		
Multiple 30 Round Magazine Holder		

* Soldier Enhancement Project

DISMOUNTED COMBAT SOLDIER

NEAR FY 94-95	MID FY 96-99	FAR FY 00-08
DOES	*DOES NOT*	*DOES NOT*
SUSTAINMENT (con't)	SURVIVABILITY	MOBILITY
RLW-30 Day	Specs/BLEPS P3I	Individual Lift
Dust Prot M16M4*		
ECWCS/WCWSS	SUSTAINMENT	COMMAND & CONTROL
Knee Pads*	Tactile Glove	Soldier's Computer
Cold/Wet Boot		Integrated Helmet
Neckgalter*		Global Positioning System
Arctic-Ration		Soldier Radio
MRE 12-14w/FRHD*		Digital Compass
Ind Endothermic Chiller*		
Soldiers' Pocket Knife/Sheath*		
Hot Weather Boots, Imp*		
Hot Weather BDU Cap*		
Imp M249 Blank Firing Adapter*		
Self-heating Meal Ready-to-eat*		
Intermed Cold/Wet Glove		
Enhance Hot Weather BDU		
Snow Camo Over - Whites		
3 Pattern Desert BDU		
The Sock System*		
MOBILITY		
Ld-Bearing Vest Tropic*		
Ind TAc Ld-Carrying Vest		
Pk Lg Internal Frame		
Harness, Single Point Release (M)		
Imp Mil Skis/Ski Binding*		
MK19/M2 Lightweight Tripod*		
COMMAND & CONTROL		
Voice-Ducer 2-Way Commo Elem*		

* Soldier Enhancement Project

The assessment in the following figure identifies gaps in progress that must be filled in order to meet stated requirements.

Dismounted Combat Soldier

MISSION AREA	NEAR TERM	MID TERM	FAR TERM	COMMENTS
LETHALITY				
Objective Individual Cbt Wpn	A	A	G	M16A2/M16A3/OICW
Integrated Night Vision	R	A	G	TWS/TEISS
Heads-Up Display	R	R	A	TEISS Integrated Helmet
C2 & Acoustic Sensors	R	R	G	TEISS
COMMAND & CONTROL				
Fully Integrated B2C2	R	R	G	TEISS
Secure Communications	A	A	G	Sqd Radio/TEISS: Soldier Radio
Position Navigation	R	R	G	TEISS: GPS
Information Storage	R	R	G	TEISS: Soldier Computer
SURVIVABILITY				
Integral Battle Hazard & Environmental Protection	A	A	A	TEISS:
NBC Protection	A	A	G	TEISS: Imp Prot/Heat Stress
Flame Protection	R	R	G	TEISS: White/Red Phos Protection
Lightweight Armor	A	A	G	TEISS:
Ballistic/Laser Visor	A	A	G	TEISS: Multi-Threat Laser Eye Prot
Multi-Threat Warning	R	R	A	TEISS:
Ambient Micro-Climatic Cooling	R	R	A	TEISS:
Combat Identification	R	A	G	TEISS: Fire Control Sys
SUSTAINMENT				
Battery Improvements	R	R	R	
Food, Water, Waste Mgt	A	A	G	
Medical Improvements	R	A	A	TEISS: Medical Monitor
MOBILITY				
Lighten the Load	A	A	A	TEISS
Modular Load Bearing Armor to Carry More of Soldier's Ld	A	G	G	Load Carrying Vest/40mm Gren Vest

COMBAT GROUND CREW.

This paragraph identifies the unique mission requirements of the combat ground crew soldier system in respect to the five Soldier System capabilities. Mission requirements/deficiencies that have commonality with other soldier categories are not included here.

Deficiencies.

- Lethality. Improvements aim to ensure crewmen can "fight"/operate their weapon system/vehicle with minimum or no interference from their uniform/protective gear.

- Command and Control. .Armor crewmen must rely on the communications systems integral to their combat vehicle. Mounted crewmen musr be unencumbered. They should also be able to monitor the status of their systems through the use of a "heads-up display." A major problem in NBC environents is sensory deprivation while in MOPP IV protection. Improved Command, Control, Communications devices should offset this problem, thereby reducing degradation and the additional training currently specified.

- Survivability. Combat Vehicle Crewmen face multiple threats. While their vehicle provides significant protection, the crewmen's uniform must offer a back-up protection system while mounted and be their primary protection while dismounted. While dismounted, the crewmen may require anti-detection improvements to include visual, infrared, and millimeter wave suppression. It is desirable to layer protection from ballistic, NBC, and environmental effects so the crewmen are unhindered while mounted but have the option of donning layers while dismounted, if the threat or environment warrants additional protection. A Ballistic/Laser Armor Protective Posture (BLAPP) is being developed to assist commanders to balance trade-offs between survivability and mission effectiveness.

- Sustainment. Only those unique concepts peculiar to the mounted crewmen are covered here. The desired objectives include:

  - Water. A water chiller/heater preferably integrated with a ration warmer/chiller to minimize space and bulk. A means to remove distasteful chemicals after chlorination is desirable. A hands-free, mask drinking system is required.

  - Survival gear must be built into the uniform to permit soldiers to escape and evade to friendly forces. The kit should include supplies for up to three days and include water, first aid, compass or other navigational device, water purification, communication means, fire starter/fuel, and nutrition/energy bars.

  - Hygiene. Crewmen must have the ability to take showers at least weekly and wash and shave daily. Laundry must be done periodically (weekly) with a turn-around of 48-72 hours.

  - Load Carrying Ability. The crewman requires a small, light, durable, and waterproof pack for patrolling. Also, a duffel bag with compartments and easy access to personal items is needed (and can be carried with the patrol pack).

  - Environmental Control. Backpacks should include a lightweight power source which would permit high work rate for short periods in an NBC environment (one-two hours) with only minimal degradation in performance.

  - Rest and Recuperation. Combat vehicle crews must occupy vehicles in position for long periods of time under constant threat of artillery fire. Some means of rest, perhaps via built-in hammocks, is needed until the unit is out of immediate combat. During periods when not in contact, crewmen need a small shelter (soldier crew tent) that enables them better rest when other facilities are not available. A shelter capability, built into the vehicle is desirable in the mid-to-far term.

- The mobility of the average crewman is adequate since he relies on the mobility of his combat vehicle.

Specific Concepts To Modernize The Ground Crew (Mounted) By The Year 2000.

The Generation II Solder ATD has potential applicability to the mounted soldier, especially its electronic applications. The next figure indicates the materiel solutions and reflects funded (*DOES*) or unfunded (*DOES NOT*) requirements. The figure after next indicates the assessments and the gaps that exist.

COMBAT GROUND CREW

NEAR FY 94-95	MID FY 96-99	FAR FY 00-08
DOES SURVIVABILITY Suit Contaminate Avoidance Liquid Protection B7 Inflation Vest (Armor) SUSTAINMENT ACAPS (FA) Microclimate Cooling Vest Soldier Crew Tent Mounted Ration Heater Device* Mounted Crewman Cold Weather Boot Mounted Crew Eqpt Bag*	*DOES* SURVIVABILITY Adv CVC Helmet* SUSTAINMENT Improved ACAPS Integrated Cooling Backpack Combat Crewman's Boot* Mounted Crewmen Cold Weather Glove *DOES NOT* SURVIVABILITY Vapor Protect Flame Resistant Undergarment	*DOES NOT* MACE: SURVIVABILITY Multiple Threat Body Armor Intyegrated/Hybrid Microclimate Ballistic Vest COMMAND & CONTROL Soldier Radio

Combat Ground Crew

MISSION AREA	NEAR TERM	MID TERM	FAR TERM	COMMENTS
LETHALITY				
Same as Dismounted Soldier				
COMMAND & CONTROL				
Same as Dismounted Soldier				
SURVIVABILITY				
Ballistics Frag & Flechette	A	A	G	
Flame	R	G	G	Vapor Prot Flame Resistant Undergarment
NBC	A	G	G	Suit Contm Avoid Liquid Prot
Environment	A	A	A	Microclimate Cooling Vest Cold/Wet Glove/Integ Hybrid Microclimate Ballistic Vest
SUSTAINMENT				
Individual Operational Rations	A	G	G	Mounted Water/Ration Heater
MOBILITY				
Land	A	G	G	Combat Crewman Boot

Combat Air Crew.

This paragraph identifies the unique mission inside the aircraft. Mobility outside the aircraft must include mobility under survival conditions. A two-piece flight suit and NBC ensemble are required to allow better mobility. The Aircrew Cold Weather Clothing System is required to replace current cold weather clothing. Aviator boots for desert, tropic, and Arctic regions are required for the mid-term.

Specific Concepts to modernize the air crew soldier by the year 2000.

- Future requirements need to defeat NBC and directed energy threat and provide multiple laser protection. Aircrew Integrated Ensemble provides protection from hostile environments and enhances aircrew interface with aircraft systems.
- Improved packets found in the survival vest and kits will provide a flexible system for climate specific rations and equipment.

Requirements: The materiel solutions are listed in the next figure and reflect funded or unfunded requirements in RDT&E and/or procurement.

COMBAT AIR CREW

NEAR FY 94-95	MID FY 96-99	FAR FY 00-08
DOES	***DOES***	***DOES***
SURVIVABILITY	COMMAND & CONTROL	Aircrew Integrated Equipment:
M43/43A1 CB Mask	Common Helmet	
SRU21-P Sirvove Vest		SURVIVABILITY
Survival Radio:		Pitz Goggles (Flash)
AN/PRC-92		Built-In Survival Gear
AN/PRC-112		Helicopter Emer Egress Device (HEED)
Survival Raft: SRU-37/P		
Survival Armor Recovery Vest w/ Inserts and Pockets		SUSTAINMENT
1/2 Lines Laser Protective Visors		Microclimate Cond Sys
2/3 Lines Laser Protective Visors		Improved Aural Protection
Aircrew Uniform Integrated Battlefield (AUIB)		
Cold Weather Clothing System		
Chemical Protective Undergarmt		
SUSTAINMENT		
Aviator Auxiliary Lights		
Aircrew BDU		
Aircrew BDU Camo Pattern		
COMMAND & CONTROL		
SPH-4B		
AN/PVS-6		
ANVIS/HUD		

The assessment, in the next figure, identifies gaps in programs that must be filled in order to meet the stated requirements.

Combat Air Crew

MISSION AREA	NEAR TERM	MID TERM	FAR TERM	COMMENTS
LETHALITY				
Engagement	R	A	G	Field 9mm Compact Pistol
COMMAND & CONTROL				
Flight Helmet	A	A	G	Aircrew Integrated Equipment
Survival Radio	A	G	G	Aging Radio Replaced
Auxiliary Lighting	A	G	G	System Fielded in Mid Term
SURVIVABILITY				
Directed Energy Weapons (DEW)	A	A	G	7 Lines Laser Protection Visors
Ballistic/Frag & Flechette	A	G	G	
Environmental	R	A	G	Aircrew Microclimate Cooling Systm
Flame	A	G	G	Aircrew Battle Dress Uniform
NBC				
- NBC Uniform	A	G	G	AUIB
- Protective Mask	A	G	G	Protective Mask
Recovery	R	A	G	Emergency Egress Air
SUSTAINMENT				
Same as Dismounted Soldier				
MOBILITY				
Air	A	A	G	AIE: Night Vision Devices

<u>Soldiers</u>.

This paragraph describes briefly the unique mission requirements of combat, combat support and combat service support soldiers in our "all other soldiers" category.

- Requirements. The materiel solutions for the combat, combat support, and combat service support soldier ("Soldiers") are listed on Figure 7 and reflect funded or unfunded requirements in RDT&E and/or procurement.

SOLDIERS

NEAR FY 94-95	MID FY 96-99	FAR FY 00-08
DOES	***DOES***	***DOES NOT***
LETHALITY Compact 9mm Pistol (MP/MI/MOI/CID)	SURVIVABILITY Reduced Wt Body Armor Set (EOD)	SUSTAINMENT Fluid/Fuel Resist Gloves/Boots /Suit (QM/OD) High Output Welder (OD) Universal Wrenching Device (OD) Combat Medic Knife Combat Medic Vest
SURVIVABILITY Body Armor Set Indiv Countermine (BASIC) (Eng)	***DOES NOT*** SUSTAINMENT MOS Specific Tool Kit (MSTK) (OD) Repair Kit (OD)	TEISS: COMMAND & CONTROL Soldier Computer (QM/Avn Log)
SUSTAINMENT Improved Mechanics Coverall*		SUSTAINMENT Indiv Pwr Pack (Port) for Pwr Tools (OD/Avn Log)

* Soldier Enhancement Project

Soldiers

MISSION AREA	NEAR TERM	MID TERM	FAR TERM	COMMENTS
LETHALITY				
Same as Dismounted Soldier				
COMMAND & CONTROL				
Information Management	R	R	A	Require C4 Devices w/ tie into Supply/Field/Personnel Svc Info
SURVIVABILITY				
Ballistic/Frag & Flechette	A	G	G	EOD Protective Ensemble
Blast Over-Press/Flash & Noise	R	R	A	Face/Head Protection for Hazmat Handling
Flame	R	R	G	Flame Retardant Overalls
NBC	R	R	G	Fluid/Fuel Resistant NBC Suits, Gloves, and Boots
SUSTAINMENT				
Ordnance Maintenance Soldier	R	R	R	Night Vision Goggles to Detect Color
	R	R	A	Visual Automated Tech Manuals
	R	R	G	Directed Access to Supply System
Combat Medic	A	A	G	Combat Medic Knife & Vest
CSS Soldiers	A	G	G	Improve Coveralls
	A	A	G	Improve Lift Capability
	R	R	G	Manportable Power Pack

Assessment. (For figure above.)

- Red, Green, Amber Assessment Implications. The Red, Amber, Green designations in the three soldier categories generally have modernization goals as a frame of reference. That is, the designations are not making statements about the soldier's current ability to fight. They rather depict how far any given capability is from the ideal far-term goal.

Funding Assessment Summary.

Although the programs in the three soldier categories were designated funded/non-funded, there were some relatively arbitrary designations. For instance, some programs are funded in RDTE and not in procurement, some are funded in both RDTE and procurement, and the funding lines are sufficient in some years and insufficient in others. On the other hand, the sheer number of soldier programs make it

unrealistic to describe the funding for each program. It is also extremely difficult to make general statements about funding with respect to soldier category, soldier capability, or time-frame because of the various funding idiosyncrasies. Also, some programs are more critical than others, so for a given soldier capability one non-fund among a number of funded programs could have a greater implication than meets the eye.

Nonetheless, some RED/AMBER/GREEN synopsis is essential. Assuming the acceptance of the above caveats, the following apply to those materiel solutions in the preceding figures.

- An AMBER rating applies across the three time frames of soldier modernization based on funding constraints for procurement.
- In the near-term, non-SEP items under the DOES category are GREEN due to programmed procurement funds. These items will be fielded in the near-term.
- In the near- and mid-term, SEP projects are GREEN for RDTE but have limited funds (RED rating) programmed for production. They are listed in the near- and mid-term based on their scheduled first unit equipped (FUE) date.
- Items listed under the DOES NOT categories are not funded for procurement.
- In the mid-term, an AMBER rating applies due to funding constraints in both RDTE and procurement for LAND WARRIOR components.
- Under the DOES category in the mid-term, non SEP items are scheduled for fielding.

In the far-term, an AMBER rating applies due to funding constraints. LAND WARRIOR is not sufficiently funded for procurement.

Overall Assessment. A mission need statement for Land Warrior is expected to be signed in July '93 at DA based on the results of the SIPE ATD. The Army Chief of Staff has approved this modernization program as recently as late June 93. Senior leadership at OASA (RDA) needs to be established and they need to closely monitor the funding (OMA & RDTE-Proc) for this program so that developed items are fielded to the troops promptly and actions taken to prevent the diversion from Central Funding and Fielding of OMA dollars like was done in FY 93 (a total of about $62M).

NUCLEAR, BIOLOGICAL, AND CHEMICAL.

Significance of NBC Warfare.

"It is not the sheer killing power of these weapons that represents the greatest effect; it is the strategic, operational, psychological and political impact of their use."
FM 100-5, Operations (Preliminary Draft, Aug. 92)

NBC warfare creates very taxing battlefield conditions. Operations in an NBC environment can significantly reduce agility, mobility, and overall combat effectiveness. Use of NBC weapons by threat forces can cause large numbers of casualties, degrade force effectiveness, slow the operational temp, and compartmentalize the battlefield. Any one or more of these conditions can be a significant combat multiplier for threat forces, as demonstrated in the Combined Arms in a Nuclear/Chemical Environment (CANE) series of tests. Figure 2.2.14-1 illustrates the typical mission degradation caused by an NBC environment as measured by the CANE Tests. There are solutions to these degradation problems. Training in an NBC environment is one. Revised tactics, techniques and procedures is another. A third — and key solution — is better protective equipment, better contamination avoidance equipment, and improved decontamination systems. This discussion focuses on equipment solutions, which go hand-in-hand with better training and revised procedures.

Mission Area Program Assessment.

The current program assessment is based on threat, capabilities, and requirements. The figure below provides a general assessment of the NBC mission area, using a Green/Amber/Red rating scheme. Rating definitions are:

Green — Adequate capability or quantity exists to perform the mission.

Amber — A limited capability or quantity exists to perform the mission.

Red — No capability exists, or it is incapable of defeating or providing required support.

NBC SYSTEMS ASSESSMENT				
ELEMENT	DEFICIENCIES	NEAR TERM (FY94-95)	MID TERM FY96-99)	FAR TERM (FY00-08)
NBC DEFENSE	CONTAMINATION AVOIDANCE • No Bio Detection Capability • No Standoff NBC Detectors • Limited NBC Recon • No Multi-Tagent CW Detector • Limited CW Monitoring Capability	RED	RED *AMBER (If BIOS is funded)	AMBER
	PROTECTION • ??? Degrade soldier Efficiency • CPE Difficult to Support/Maintain • Limited Compatibility w/AVN Systems • Limited BIO Vaccines	AMBER	AMBER	GREEN
	DECONTAMINATION • Logistically Intensive • Limited Capability at Battalion Level • ???? Corrosive Decontaminant	AMBER	AMBER	GREEN
SMOKE/ OBSCURANTS	• Limited Capability to Screen Infrared Sensors • No Millmeter Wave Region Screening Capability • No Light Vehicle Self-Protection Smoke System • No Multispectral Smoke Munitions • Limited Protected Smoke Capability • No Large Area Multispectral Smoke Capability • Limited Heavy Vehicle Self-Protection Smoke System	AMBER	AMBER	GREEN
FLAME/ INCENDIARY & NON-LETHAL (FINL)	• Limited Flame/Incendiary Delivery Capability • No Non-Lethal Capability	RED	RED	RED

NBC Mission Area Assessment.

This assessment provides the rationale for the ratings shown above. Dates listed are for First Unit Equipped (FUE).

- NBC Defense:

  - Contamination avoidance: **Red** in the **near** and **mid terms** due to a lack of both a biological agent detection capability and an automated warning system. Given the on-going efforts within the Department of Defense to accelerate biological defense capabilities, this area could become **Amber** in the mid term if an interim biological detection capability, the Biological Integrated Detection System (BIDS), is funded; along with the Multipurpose Integrated Chemical Agent Detector (FY97) and the Automated NBC Information System (ANBACIS) in FY97. This area improves in the **far term** with the fielding of a biological detection capability but is rated **Amber** due to limited procurement of the NBC Recon System (NBCRS) (FOX), MICAD, and CB detectors/alarms, for Force Package 1 (FP1) units. The FP1 equipment displaced by modernization does not improve other force package units, the old equipment has already been fielded to units in those force packages.

  - Protection: **Amber** in the **near** and **mid terms** due to a limited biological vaccine capability and lack of both an aircrew protective mask (ACPM) and lightweight, deployable collective protection equipment (CPE). An accelerated program to provide a vaccine capability against biological agents will provide a limited capability by FY95/96. The ACPM FUE is FY96. However, an adequate CPE capability is not available until FY06. NBC protection for Corps hospital units becomes available for FP1 units in FY95. Advances in NBC individual and collective protection equipment allow NBC protection doctrine to transition from a "carry along" protection to a fully integrated, nearly "transparent" capability by the far term; thus, we projected it to be **Green** in the **far term.**

  - Decontamination: **Amber** in the **near** and **mid terms** due to deficiencies in decontaminants and limited procurement (FP1 only) of a lightweight decontamination system for battalions. Efforts to modernize the decontamination element of the mission area focus on: replacement decontaminants for the highly-corrosive DS-2; improved systems to decontaminate equipment; and, self-decon coatings for vehicles. This area becomes **Green** in the **far term**, when an improved decontaminant (FY02) and self-strip coatings (FY01) for combat vehicles become available. Detailed equipment decontamination upgrades occur in FY98 with the fielding of the Modular Decon System (MDS) to chemical units.

  - Smoke/Obscurants: Amber in the near and mid terms due to limitations in smoke/obscurant material screening capabilities and limited vehicle self-protection smoke systems. These capabilities provide screening only in the visual and near infrared (IR) regions of the electromagnetic spectrum. Our emphasis on smoke/obscuration efforts is devoted to developing high performance, logistically supportable, multispectral materials which provide visual through millimeter wave spectral screening for large-area, projected, and self-protection systems. Evaluation is ongoing on obscurant materials and systems as countermeasures to directed energy weapons systems (DEWS). Multispectral smoke is required to defeat state-of-the-art electromagnetic sensors, targeting systems, and air-breathing overhead/remotely piloted vehicle surveillance. Multispectral smoke grenades for vehicle self-protection smoke systems become available in FY98. However, this area becomes Green in the far term with the fielding of multispectral screening materials for the XM56 large area smoke system (FY04).

Flame/Incendiary and Non-Lethal (FINL) Weapons Systems.

Red in the **near**, **mid** and **far terms** due to the lack of an anti-materiel capability and an inadequate flame/incendiary munition delivery system. Modernization efforts in the flame/incendiary area provide an improved delivery capability in the far term (FY06). The limited funding in the non-lethal area is a function of both higher priority issues and ill-defined requirements. As user requirements are more clearly defined, we require additional funding to move this area to an Amber status.

- Current FINL weapon system capabilities are:

- **Flame/incendiary weapons** - Current capability is limited to incendiary hand grenades, a shoulder-launched flame rocket, and flame field expedients constructed from fuel and demolitions.

- **Anti-materiel weapons** - None fielded today.

- **Riot control devices** - Current riot control capability is limited to grenades and backpack-mounted dispersers.

Summary.

The current modernization program provides improvements in every component of the NBC mission area to Protect the Force. However, with the current program, we will not achieve both overmatch capabilities and acquisition objectives in contamination avoidance, smoke/obscurants, and FINL. Additional funding is necessary to achieve the required overmatch capabilities outlined in this section. Our integrated strategy for NBC RD&A into the 21st century, supported by a focused technology base, is designed to achieve the following objectives:

- NBC Defense.
  - Expand the NBC contamination avoidance envelope;
  - Reduce performance degradation of Individual Protective Equipment (IPE) while improving protection capabilities;
  - Produce continuous, regenerative collective protection filtration systems requiring minimal maintenance and logistics, and;
  - Produce highly mobile, self-sustaining decontamination systems.
- Smoke/Obscurants.
  - Improve our capability to counter enemy RISTA assets across the electromagnetic spectrum.
- FINL weapons systems.
  - Improve flame/incendiary weapons to attack large areas and hardened targets; and
  - Improve non-lethal weaponry to reduce collateral damage in urban environments.

Our modernization efforts are implemented via judicious use of ATDs, technology demonstrations, technology insertions, and system upgrades. Technology advances are systematically incorporated into development programs as practical to provide significant overmatch gains while reducing long lead times.

Many enabling strategy initiatives currently underway are described in this section, including initiatives in acquisition and R&D improvement, concurrent engineering/Computer-Aided Acquisition and Logistic Support, advanced integrated manufacturing and Operations and Support Cost Reductions. Development and production cooperative agreements, with domestic and international partners, provide a means to cost share, and in some cases, reduce acquisition time. Horizontal integration of enhanced NBC capabilities across all mission areas provides significant gains in operational survivability and mission sustainment and is critical to the modernization effort.

The NBC RD&A strategy provides capabilities which overmatch the NBC threat, and it protects the force while reducing end items, manpower, logistics requirements, and cost. This strategy focuses on products which provide versatility, deployability, and survivability. The NBC modernization plan contributes to the Army's land force dominance and improves our ability for decisive victory.

INFORMATION MISSION AREA (IMA).

INFORMATION MISSION AREA

FINDING: BOTH THE PROCESS AND THE PRODUCTS OFIMA MUST BE SIGNIFICANTLY IMPROVED.

- PROCESS: IDENTIFY WAYS TO LEVERAGE ADVANCES IN INFORMATION TECHNOLOGY IN THE PROCUREMENT OF NEW INFORMATION SYSTEMS OR UPGRADES TO EXISTING SYSTEMS WHICH SUPPORT FORCE EFFECTIVENESS.
  - USE BATTLELABS / SIMULATIONS AND CURRENT INFORMATION TECHNOLOGIES SUCH AS OBJECT ORIENTED DESIGN / ANALYSIS AND CASE TOOLS.
  - SUPPORT THE APPLICATION OF INTEROPERABILITY, MODULARITY, AND MAXIMUM USE OF COTS PRODUCTS.

INFORMATION MISSION AREA

- PRODUCTS: DEVELOP AN OVERARCHING INFORMATION FRAMEWORK THAT INCLUDES COMMON DATA STANDARDS, COMMUNICATIONS PROTOCOLS, AND SECURITY MEASURES .
  - USE SYSTEMS / SOFTWARE DEVELOPMENT APPROACHES CONSISTENT WITH SEI AND INDUSTRY STANDARDS
  - DEVELOP AN INFORMATION MANAGEMENT / DATA ADMINISTRATION PROGRAM TO ENSURE INTEGRITY, COMPLETENESS, ACCURACY, AND TIMELINESS OF DATA.
  - CONSIDER THE INTRODUCTION OF GEOGRAPHIC DISPLAYS / GIS AND AUTOMATED KEY MANAGEMENT SYSTEMS.

Introduction.

- Overlap with the following major systems:

  - Command, Control and Communications
  - Fire Support
  - Logistics
  - Medical
  - Training

- Rationale for inclusion of systems and/or technologies in the IMA functional area.

- Definitions of infusion, insertion, and integration with respect to the IMA.

Systems Considered.

- Statement of the six-part criteria

- Application of that criteria to the following systems:

  - Sustaining Base Information Services (SBIS)
  - Installation Support Module (ISM)
  - MACOM Telephone Modernization Plan (MTMP)
  - Outside Cable Rehabilitation (OSCAR)
  - Common User Installation Transport Network (CUITN)
  - Army Gateway Program (AGP)
  - Reserve Component Automation System (RCAS)
  - Joint Computer-Aided Acquisition Logistics System (JCALS)
  - Defense Message System (DMS) - Army

- Identification of the systems to be considered further.

- Digitization of the Battlefield

Systems Discussion.

- Desirable Characteristics

  - Interoperability
  - Modularity
  - Commercially Available
  - Data Standards

Technologies.

- Corporate Information Management Initiative

- Data Compression

- Graphical Displays/Geographical Information Systems (GIS)

- Open Systems Environment

- Information Security Technologies

MEDICAL.

General. The study and practice of medicine perpetuates medical advancements in treatment and procedures at exponential rates. The advancements in preventative medicine (physical conditioning, nutrition awareness, cessation of the use of tobacco products, etc.) and the development of new drugs and vaccines have significantly increased the health of our soldiers. Advancements in patient care techniques, coupled with the explosion of new medical materiel and equipment, have been instrumental in the modernization of the Army's health care system. State-of-the-art medical equipment is required in medical units to provide the best care available to our soldiers. Research, development, and acquisition (RDA) efforts needed to address deficient areas are underway.

Army Medical Department (AMEDD) developed the Army's Health Service Support (HSS) doctrine to implement and manage an integrated health care system providing requisite care from the point of injury to the CONUS base. This doctrine, coupled with AMEDD leadership's version of the future, provided the cornerstone for the development and fielding of a medical force structure known as MF2K. The fielding and equipping of MF2K is an excellent example of AMEDD's modernization initiatives. MF2K rectified many of the battlefield deficiencies associated with providing HSS to our soldiers. The design took full advantage of modernization equipment, personnel staffing, and enhanced medical capabilities. Continuous modernization is required to provide our soldiers the most effective and efficient HSS system available. The recent political and military changes in our world, combined with a new National Military Strategy, demand changes and modernization to provide the most effective and efficient health care to our soldiers.

Assessment Criteria.

An assessment of the Medical Force 2000 (MF2K) capabilities is depicted in figure below. The funding for Army programs is part of an overall OSD program. The parameters of the analysis were constrained to address battlefield warfighting needs in doctrine, training, leader development, organizations, and materiel (including science and technology) to support the soldier (DTLOM).

The assessment was further constrained to materiel enhancements or requirements that are essential to providing health care on the battlefield. The definitions of the RED/AMBER/GREEN rating criteria were applied to facilitate standardization of ratings and to describe capabilities.

MODERNIZATION OBJECTIVE	WARFIGHTING NEED	NEAR (FY 94-95)	MTD (FY 96-99)	FAR (FY 00-08)
Project and Sustain	Far-forward surgical care	Green	Green	Green
Project and Sustain/ Protect	Prevent/minimize endemic disease/ environmental injury	Amber	Amber	Amber
Project and Sustain	Provide medical materiel and blood	Amber	Amber	Amber
Project and Sustain/ Protect	Develop NBC agent protective measures			
	Nuclear	Amber	Amber	Amber
	Biological	Red	Red	Amber
	Chemical	Amber	Amber	Amber
Project and Sustain/ Protect	Provide care for non-battle injuries and disease in peacetime competition	Amber	Amber	Green
Project and Sustain	Provide medical treatment for battlefield wounds, injuries, and disease	Amber	Amber	Amber
Project and Sustain/ Protect	Provide diagnostic and treatment capabilities for DE injuries	Amber	Amber	Amber
Project and Sustain/ Protect	Provide treatment to dental patients	Amber	Amber	Amber

- RED - No capability exists, or it is incapable of defeating the threat.
- AMBER - A limited capability or quantity exists to defeat the threat and perform the mission.
- GREEN - Adequate capability or quantity exists to defeat the threat and perform the mission.

Conclusion.

Things are in pretty good shape. Only the biological agent protective measures are red. Actions are underway to define the threat in possible areas of deployment, to develop the vaccines, and to put in reserve stocks the appropriate vaccines for future use.

TRAINING SYSTEMS.

The training systems in this section are the "non system" training systems. That is, those training programs, devices, simulators and simulations specifically connected to Army systems such as Close Combat Heavy and Light, etc. are not covered. Currently, the Army manages the system specific and non system training systems as two independent programs.

Systems Considered.

The systems considered and selected for analysis are shown in the figure below. The systems fall into the following categories:

- Virtual Simulations. This category includes a collection of task training simulator systems using the distributed interactive simulation architecture and protocols. Systems in this category include SIMNET and the Combined Arms Tactical Trainer (CATT).

- Constructive Simulations. This category includes wargames, models, and analytical tools referred to as the Family of Simulations (FAMSIM). These include the Corps Battle Simulation (CBS) Program, JANUS, and the Brigade/Battalion Battle Simulation (BBS) Program.

- Live Simulations. These include training operations with equipment in the field. These devices are used at the Combat Training Centers (CTC) such as the National Training Center (NTC), Joint

Readiness Training Center (JRTC), the Combat Maneuver Training Center (CMTC), and home station training. These include simulations such as the Multiple Integrated Laser System (MILES), MILES Air Ground Engagement System (MILES -AGES), Aircraft Survivability Equipment Trainer (ASET IV), Air Combat Maneuvering Instrumentation (ACMI), and the Tank Weapons Gunnery Simulation System and Precision Gunnery System (TWGSS/PGS).

- Ranges and Targets. This category includes range instrumentation, targetry and devices. Systems include remote target system (RETS), precision range integrated maneuver exercise (PRIME), the Armor integrated thermal signature target (AITST), and the lightweight moving target system (LMTS).

- Ammunition. This includes all ammunition used for training.

	Systems Considered	Reason for Deletion
VIRTUAL SIMULATIONS		
	Simnet	6
	Combined Arms Tactical Trainer (CATT)	3
CONSTRUCTIVE SIMULATIONS		
	Corps Battle Simulation Program	6
	JANUS	
	Brigade/Battalion Battle Simulation Program	6
	Combat Service Support Training Simulation System	6
	Intelligence/Electronic Warfare Training Device (IEWTPT)	3
LIVE SIMULATIONS		
	Multiple Integrated Laser System (MILES)	
	MILES Air to Ground Engagement System- (MILES AGES)	
	Aircraft Survivability Equipment Trainer (ASET IV)	
	AIR COMBAT MANEUVERING INSTRUMENTATION (ACMI)	1
	Tank Weapons Gunnery Simulation System and Precision Gunnery System (TWGSS/PGS)	3
RANGES AND TARGETS		
	Remote Target System (RETS)	
	Precision Range Integrated Maneuver Exercixe (PRIME)	
	Armor Integrated Thermal Signature Target (AITST)	
	LightWeight Moving Target System (LMTS)	
AMMUNITION		

Systems Discussion.

Unlike other systems discussed in this report, Training systems cut across a wide spectrum of requirements. Training systems are required to ensure that our Total Army - Active Component (AC) and Reserve Component (RC) - is ready to implement the National Military Strategy (NMS). The Army has developed the Combined Arms Training Strategy (CATS) as the conceptual framework for establishing Total Army training resource requirements. CATS is the Total Army's architecture to train and educate its people and units. The Army focuses its training resourcing through the Training Mission Area (TMA). The TMA programs provide the training aids, devices, simulators and simulations (TADSS) necessary to meet the breadth and complexity of requirements. These requirements, as stated in the 1993 Training Annex to the US Army Modernization Plan include:

- Train leaders and soldiers, at schools and units, in individual and collective tasks necessary to mobilize, deploy, conduct combat operations, redeploy, and demobilize the force.

- Train commanders and staffs at all levels (company/team through theater level via joint and combined scenarios) in skills necessary to exercise command and control of subordinate units, examine tactical standing operating procedures and synchronize with higher, adjacent and other supporting elements during execution of AirLand Operations.

- Provide tough, realistic joint and combined arms and services training at dedicated training areas in accordance with AirLand Operations doctrine for brigades and battalions across the operational continuum.

- Train tasks and skills across all the battlefield operating systems in institutions, in garrison at home station, at Combat Training Centers, major training areas, and regional training sites.

- Train leaders and units to synchronize and employ combined arms assets through realistic live fire/laser gunnery exercises on standardized ranges.

- Develop exercises that include the full range of situations in the operational continuum and the full planning range from force generation through force employment, war termination, and redeployment.

- Develop and implement a common architecture and associated standards which support the interpretability and interconnectivity functions and dynamic interactions which affect the conduct and results of warfighting.

As the Army's budget is reduced and the Army is downsized, training requirements continue. At the same time, there is increasing pressure to reduce training time, expenditures on ammunition, and usage of combat vehicles (Operating Tempo OPTEMPO). Coincident with these demands there is increased emphasis on safety and environmental considerations. Therefore, the need for training systems which minimize the use of land, ammunition, OPTEMPO, and transportation time while providing realistic training is increasing.

Current Capabilities/Deficiencies.

Current training systems go a long way toward meeting these requirements, but they also have deficiencies. These are discussed below:

- Ability to Provide Realistic Training Onsite, On demand, Worldwide: At the present time, there are an array of systems and non system training devices and simulations to meet the requirement for individual, crew and collective training. These systems have not been linked into an integrated simulation environment that can be packaged and scaled to address a variety of uses and environments. The Army strategy is to move to a seamless simulation environment by the year 2000. A major requirement in this strategy is to embed training capabilities into weapon systems so that training can be conducted on site, on demand as needed.

- Tactical Engagement Simulations: These simulations are employed to replicate weapons lethality, unit coordination and battlefield synchronization requirements. Currently there is a limited supply of systems and instrumentation for tactical engagement simulations. These are strap-on systems to weapons systems. They are large and bulky, difficult to transport and costly to remove and replace and are frequently damaged during the process. If these were embedded in the weapon systems they would be available for training on demand for all commanders. In addition, they would provide for immediate training application at the Combat Training Centers (CTCs), as well as training capability on remote/foreign battlefields.

- Realistic, Real-Time, Fully Integrated Combat, Combat Support, And Combat Service Support Training Simulations For Battalion Through Theater Army: The training simulation systems in existence today do not allow for the full play of all functions. The Army is planning to go to a new system (WARSIM 2000) rather than upgrade current simulation capabilities.

- Realistic Representations Of A Multiplicity Of Terrain: The representation of terrain in current simulations is limited in range of coverage and fidelity of representation. There are several standards for fidelity of representation, there is a limited amount of the earth's surface that has been digitized, and there is no capability within current systems to change terrain in response to engineer or combat circumstances. These factors limit the training effectiveness of virtual and constructive simulations.

- Mobilization And Demobilization Training: Training systems and methodologies for rapid mobilization and demobilization training is seen as a major deficiency. Many of the training systems anticipated for the future will address this deficiency.

- Range Instrumentation and Target Systems: These systems provide for both live fire and non live fire training exercises. The Army's current range mechanisms for marksmanship and gunnery ranges are rapidly becoming obsolete. Many ranges are maintenance and environmental liabilities and, with few exceptions, do not provide for realistic, threat-oriented training. Target control systems are nonstandard and difficult to service. Currently, live fire targets can not withstand multiple, sustained hits and continue to function properly. Further, there is a requirement for portable ranges to meet the needs for distributed training, on demand.

- Reusable Training Ammunition, Grenades, Mines And Other Devices: There are major issues of cost, environmental hazards and safety with the use of live ammunition, hand grenades, mines. etc. Devices have been designed for commanders to use to provide realistic training while simulating the effects of actual ammunition and devices. However, many are lost after a single use and in some cases destroyed. As the Army goes to MILES compatible devices, the cost of losing training ammunition and devices will grow.

- Training for multiple environments. Currently, there is a limited capability to simulate multiple environments such as combat in urban environments. WARSIM 2000 will provide for this capability.

Technologies.

Potential upgrades to the training systems identified in figure above include:

- Common Terrain Data Bases: There is a need for rapidly reconfigurable terrain data bases that allow for development of geospecific terrain photo-based images. The problem is the conversion of information resident in current topographic maps and the Defense Mapping Agency digital terrain data bases. Technologies available are advanced computer image generators and a technology that scans topographic maps and merges elevation data so that a user can process the information from a number of perspectives. With the current Army strategy, JANUS is the only system that is a candidate for this technology insertion. At the same time, the integration issues and the state of technology may make this a questionable expenditure. The better strategy may be to invest in the new systems as planned.

- Embedded Training and Tactical Engagement Simulations/ Instrumentation: Embedded training capabilities and tactical engagement simulations and instrumentation should be considered for Horizontal Technology Insertion into the weapons systems discussed in other sections of this report. To add embedded training to weapons systems they need to have a digital architecture to include high resolution inputs and outputs. Candidate systems include the M1A2, M2A3, AFAS, Commache, Apache, ATACMS and MLRS.

Conclusions.

Horizontal Technology Insertion (HTI) has limited applicability for training systems. Embedded training should be considered as a major technology insertion for current weapon systems that are configured appropriately. In addition, the technologies identified in other parts of this report such as combat

identification, pos/nav, command and control digitization, etc. should be considered for HTI in training systems as they are inserted into other systems.

SPACE.

This section identifies current Army options for space. Declining Army resources and worst case budget cuts take RDA dollars to acutely low levels; and yet, the support to land operations provided by space based systems demand that the Army be a major player in Space. The Army can not invest in Space unilaterally. It must be a part of joint funding. Space investments will be difficult but not impossible.

RDA Focus.

The RDA focus for the 1990s is on horizontal insertion of technology into platforms rather than new systems. There will be no Army unique space systems or new starts.

Ground Commander's Needs.

The Army must address the ground commander's needs:

- Support to contingency theater CINCs.
- Enhanced lethality for early entry forces.
- Reconnaissance, targeting, weapons delivery, and damage assessment.
- Situational awareness and IFF.
- Incorporation of GPS into precision strike munitions.
- TMD/GPALS with SDIO.

TENCAP.

The Army will continue to exploit National capabilities.

One Set of Programs.

The Army should merge the special access programs and the in-the-clear programs into one set of commands and management.

Space Capabilities.

Funding for space capabilities will be predominantly for payloads, down linking of information, and universal ground stations that process all source information.

APPENDIX C

PEO/PM

APPENDIX C

PEO/PM IMPLICATIONS

PEO/PM IMPLICATIONS

- NO MAJOR CHANGES TO PEO/PM ORGANIZATIONAL CONCEPT REQUIRED *BUT* A MAJOR CHANGE IN THE WAY PEO/PMs MANAGE PROGRAMS.
  - Decreased government overhead
    - Risk management forecasted with contract
    - Less oversight of contractors
  - DIS exploited throughout development programs
  - Increased coordination between PEOs and PMs of different systems
  - Centralized funding
- MANAGEMENT OF HTI PROJECTS WILL VARY.
  - Centralized procurement
  - Decentralized by system
  - Separate PEO/PM (Battlefield Digitization; 2nd Gen FLIR Modules)

The current organization and concept of the Program Executive Officer/Program Manager (PEO/PM) system do not require major changes to implement the recommendations of this report. The basic concept of PEOs and PMs implemented by the Army in compliance with the Goldwater-Nichols Law are sound and should not be abandoned.

However, there will be some major changes in the manner in which PEOs and PMs manage programs. Reduced government overhead will reduce, by necessity, the ability of PEOs and PMs to manage the day-to-day details of a program. More management responsibility will be contractually passed to the contractor. This includes the focus of risk management, process control, a majority of the manufacturing inspections, and total responsibility for all components. This does not exempt the PEO/PM from responsibility for cost, schedule, and performance of an assigned system but does require becoming a smart buyer by judicial deletion of many reports, etc., which add no value to the program. They must continue to be aware of day-to-day problems and progress of the program, but the requirement to sign off on every detail will diminish.

Every PEO/PM must be totally familiar with Distributed Interactive Simulation (DIS) and the value of its use in reducing testing and the old test-fix-text-fix way of doing business. As risk is reduced by the two-step development model the final design should not require the degree of redesign frequently encountered in past developments.

Horizontal technology integration (HTI) will require an increased level of coordination between PEO/PMs of different systems to assure that commonalty is enforced across a wide spectrum of systems.

Centralized funding of HTI programs will reduce some level of control by individual PEOs and PMs, but will assure that the HTI program is properly funded and not reduced by the system PEO or PM to fund a lower priority upgrade.

There is a policy emerging as to how each HTI program will be managed. It will vary in accordance with the program complexity and the number of systems into which it will be integrated. However, usually HTI components will be acquired by product managers, and HTI and Vertical Technology Insertion (VTI) will be performed by the platform program managers..

The more complex HTI programs could require a PEO or PM to assure timely development and application across a wide variety of systems. For example, battlefield digitization is so complex and applies to so many systems that a PEO and one or more PMs may be required to assure its timely and coordinated implementation across the force.

APPENDIX D

INDUSTRY

APPENDIX D

INDUSTRY

The downward spiral of defense procurement funds has had a significant effect on the defense industrial base, both public and private. There have been substantial changes in the private industrial base as we knew it in the mid-1980s. Tens of thousands of small vendors have gone out of business or converted to the production of non-defense items. While the total number of prime contractors has not dropped substantially in total numbers, there have been significant changes in its makeup. Some corporations have increased their holdings in the defense base, such as Martin Marietta and Loral, while others have divested themselves of large defense sectors, such as GE and General Dynamics. All have downsized production capability to operate more efficiently at lower production rates. A limited number have attempted to broaden their commercial base. Because large sectors of the defense industrial base are a monopsony, it behooves the Department of Defense (DoD), to include the Army, to change the manner in which it deals with industry. This is particularly true of those sectors of the base for which there is no counterpart commercial market. All of these factors lead to one conclusion. The Army must change the manner in which it deals with industry. It is fully recognized that there are a number of impediments to rapid change, but it is believed that the Army can make significant headway within the current regulations and laws.

- Industry leaders have indicated to the Army that they can reduce the cost to the Army by one-third if procedures similar to those indicated above are instituted. They should be challenged by the Army to prove this point during the pilot programs. If they cannot prove their assertions, then profits should be reduced until they improve their processes.

Much can be done by the military and industry to improve the way they do business. The Army should take the lead in the DoD to adopt new ways of doing business. This will not only improve the Army's combat effectiveness, but change its reputation with Office of the Secretary of Defense (OSD) and industry as an agency that is hard to do business with.

- There is no question that reduced defense budgets will reduce the number of programs in which competition proves to be cost effective. However, there are a number of ways in which the government can contractually commit a manufacturer to improve efficiency and reduce costs in a sole source contract. Efficiency goals can be established which require the manufacturer to improve his production processes or lose profit. On the other hand, if the manufacturer exceeds the goals, he should be able to share the savings with the government, and hence, increase profit. The Army has a right to expect prices to remain the same or decrease in then year dollars. In other words, the contractor must attempt to stop passing inflation on to the Army by instituting productivity improvements which meet or exceed inflationary salary and benefit cost increases. An example would be to agree to meet productivity improvement of 5% per year for a 3 year contract. (Productivity here is measured in the classic price/cost manner . . . inflation is absorbed.) For those three years, share the profit improvement with the contractor 50/50 and do not lower the target profit in recognition of that share. Realize that three years hence the cost product could be 15%+ (5% compounded) lower when a new contract is negotiated to this lower cost/price baseline. If a contractor refuses to improve productivity reflected in price, it is time to consider a new arrangement. Impossible as this may seem, there are always ways to enforce productivity improvement, but this is an unlikely occurrence in a trust environment. The contractor would want to offer improved value to the Army, and probably welcome real productivity measures as long as he has a real shot at

significantly improved profit for some period of time. Another way to incentivise contractors is to improve the value engineering change proposal (VECP) process which is so cumbersome that it does not meet its potential to improve processes. The rules of VECP use should be simplified to speed the approval process and incentivise industry to aggressively pursue design and process improvement.

- In cases which involve significant technology risk during the research and development phase, the Army should employ the two--step acquisition process. It should then normally restrict bidders to those who have exhibited by past performance an ability to perform a full service capability in research and development, production and post-production support. This procedure is not designed to preclude new competitors from entering the market; however, they should be required to prove to the Army that they have the three capabilities indicated. Over a relatively short period of time (four-eight years), this procedure will result in a stable of highly qualified full service contractors in which the Army will have a high level of confidence. Only by eventual restriction to qualified bidders will the Army be able to assure survivability of highly qualified suppliers. As competitive advantages decrease because of a reduced number of suppliers, more multi-year contracts should be awarded. The procedures indicated in the preceding paragraph will assure that the government receives full value for the assets expended.

- The Army should take the lead in the DoD to change the way it does business. This will not only gain support in industry, but in the DoD, which is stressing in words, if not in practice, a desire to change the way it does business. They should be challenged to put into practice the principles they are mouthing. It has been estimated that up to 30 percent of the cost of a military system is due to excessive requirements, audits, inspections, reports, etc. The Army should take immediate action to establish several pilot programs in which the manufacturer is contractually committed to certify production techniques, quality of components and in-process inspections similar to the manner followed in the commercial world. The only inspection would be a final inspection to ensure that the product meets the contractually required performance capabilities. Inherent in this way of doing business will be a substantial reduction in the number of government auditors and inspectors. It is fully recognized that these pilot programs must be supported by the Defense Logistics Agency because many of the rules, regulations, audits, and inspections are outside the Army's capability to control. These same pilot programs should utilize performance specifications for the end product, rather than extremely detailed requirement specifications for every detail of the system. These specifications frequently drive up the cost of the final product without materially increasing the overall capability of the system. The Program Executive Officer/Program Manager, and contractor should be provided more latitude in trade-offs, so long as they do not reduce the performance specifications for the system. Along this same line, defense industry is striving to adopt "Best Commercial Practices" in spite of a tendency of the military to stick to the old way of doing business, including such barriers as excessive military specifications, a myriad of reports of little true value, excessive oversight of development and production, extremely complicated cost accounting procedures, and a lack of incentives to introduce efficiencies into development or production. The military is not totally to blame in this regard because defense industry itself has grown so accustomed to the way it does business with the military, that it is sometimes hesitant to change. Both the Army and industry must work together to break the mold. Working as a team, the Army and industry can change the way they do business and make the maximum use of limited funds.

A first step is to adopt a policy of "Best Commercial Practices" in all development and production programs. Another area is use of commercial products where, with few exceptions, the Army has shown little inclination to directly adopt them when they are available. Such items as global positioning systems and commercial trucks have been procured in limited numbers. Additional emphasis should be placed on buying items directly off-the-shelf when they meet 80 to 90 percent of a requirement at considerable cost savings. Items that appear available in this area include individual clothing and equipment, engineer equipment, trucks, computers, communications equipment, global position system (GPS) receivers, and a multitude of other items. There is frequently a desire to harden or "militarize" commercial products for military use. In some cases, this makes sense; however, it has frequently been used to excess in the past resulting in a unique military item at no cost savings. A good example has been the Army's frustrated attempt to procure a motorcycle. "Militarization" of commercial products should be de-emphasized to the maximum extent possible.

APPENDIX E

COMMODITIES

APPENDIX E

COMMODITIES

Quick Response (QR): Commodities for Clothing & Textile.

QR is a new business strategy that is already being implemented in the clothing and textile industry. It is a system whereby improved business procedures and electronic information technology results in more efficient operations and increased inventory productivity. It also improves customer service and decreases overhead costs.

This section discusses the advantages of QR and its applicability to the Clothing & Textile Directorate at Defense Personnel Support Center (DPSC). It also provides an update on DPSC's efforts to date in the electronic commerce arena and the future possibilities.

More importantly, it presents a plan to implement QR in the Clothing & Textile Directorate. The purpose is to establish a pilot program utilizing one item with close commercial similarities, one vendor which is already involved in commercial "Quick Response," and one Service customer through their Recruit Induction Center(s).

Once the methodology is proven, QR can then be expanded to large scale application in Defense Logistics Agency (DLA) and for appropriate Army acquisitions.

Historical Perspective of QR.

A brief history of the changing environment of American business is necessary before one can discuss QR. The US industry has been under attack--an attack not military in nature but every bit as dangerous. Imports have struck deep inroads into many industrial areas. One need only study the automobile, electronic, textile, or computer industries to see the impact of imports. For example, in 1988, the clothing industry accounted for $20 Billion of the US trade deficit, second only to the automobile industry. Contributing to this imbalance is the fact that average wages in Latin America and the Pacific Basin are about $1 per hour, and in China, about $.20 per hour.

It is not that imports in and of themselves are the cause of the problem. Rather, they are only the symptoms. The real culprit is the failure of US business to adapt to the new environment of a world-wide economy. Traditionally, the apparel industry has taken a product-oriented rather than a market-oriented approach to its business. They failed to see, as did many other industries, that a business must see itself as a link between the initial producer and the consumer of the goods. They also failed to see that their competition is now the entire world market.

Recently, America has experienced a re-awakening. US industries are taking on a leaner, meaner look. Investments in capital equipment, plant re-tooling, and technology innovations are ever increasing. Yet, without a more fundamental change in the way America does business, it will not be enough. US industry has discovered that they can no longer afford to carry excessive inventories. No longer can hard-copy paper systems or batch computer systems and their inherent time delays be tolerated. No longer can components of the business chain, such as warehouses, be allowed to exist as a "cost-added" rather than a "value-added" element. In a recent study, IBM figured that warehouse personnel perform 38 functions-- four of which added value, 34 of which only added cost. American business has discovered that it is not too late to change. In fact, the change has already begun in the clothing and textile industry through a process known as QR.

QR at DPSC.

Where does QR fit in at DPSC?

DPSC is basically a retailer. The center forecasts sales; contracts with vendors for supplies to satisfy the projected sales; maintains inventory levels at distribution points across the country; and services sales stores with stock. These sales locations can be Recruit Induction Centers (RICs), Army and Air Force Exchange Stores (AAFES), service issue sales stores, or other government agencies. DPSC also encounters stock-outs and surpluses as with any other retailer.

In other words, DPSC operates in very much the same manner as those retailers who are implementing QR. In point of fact, the center is involved in the same commodities as the QR communities. All major supermarkets (subsistence), drug stores (medical), and clothing retailers (clothing & textile) are currently employing some type of a QR system.

Clothing & Textile Applications of Electronic Commerce.

Within the Clothing & Textile Directorate, the beginnings of an electronic commerce program have been taking shape. Members have been attending the QR seminars to obtain the latest available information. A major retailer has made a presentation to top DPSC officials regarding their use of QR. We are in the beginning stages of electronic purchase orders, having just implemented a computerized system called *SPEDE PLUS* in our small purchases. We will soon be expanding this electronic ordering system to other areas.

The Clothing & Textile Directorate is also utilizing bar codes to track inventory at the depot level. We now use LOGMARS bar-coding on exterior shipping containers. This allows information to be picked up at the depot level. This data is used for the purpose of inventory management. However, it must be noted that LOGMARS is not the universally accepted bar code system in industry.

ADVANTAGES OF QR:

Advantages to DPSC.

Currently the Clothing & Textile Directorate acquires supplies which are placed in warehousing facilities for eventual shipment to the customer. The logistical costs of shipping items to the depot, receiving the stock, warehousing the supplies, taking inventory of the goods, and re-shipping to the customer are substantial. Additionally, DPSC carries a very large safety level of stock to support our customers.

QR is a system that bypasses the entire warehousing structure. It entails producing an item when the customer needs it and then shipping it directly to the customer. DPSC can then almost simultaneously bill the customer and pay the vendor. The savings to DPSC in cost of money, use of facilities, and freed-up obligation funds would be significant. This initiative supports DMRD #903 which tasks DPSC with reducing its depot stock.

Advantages to the Services.

When the Services requisition an item from DPSC, they can anticipate that it will take a certain amount of time to be received. For that period of time, they carry their own safety level. Under a QR system, that time will be drastically reduced, thereby allowing the Services to carry less inventory and thus a save money.

Further, every item purchased from DPSC carries a surcharge commensurate with the logistical costs involved in supplying that item. Since a QR system would reduce that cost to DPSC, we would propose to reduce the surcharge to the Services proportionally.

Advantages to the Vendor.

The vendor selected to participate in a QR system with the government will benefit indirectly. They will be able to operate in a manner most like their commercial operations while at the same time perfecting a QR program that they can export into the commercial market. The vendor will also be lined up with the government in a contractual arrangement which should assure continuity of production.

The QR System in Operation.

An overview of how the system will look is provided below. However, it is important to note that the visits to the Service representatives and industry leaders are crucial, for the information we learn will enable us to flesh out the final detailed plan.

The Recruit Induction Center (RIC) or RICs will provide their asset picture and choose a reorder point by size for the chosen item to both the vendor as well as to DPSC. The Service will identify the recruit class for the upcoming year in as much detail as is available. Finally, the RIC or RICs will provide Point of Sale (POS) information on a regular basis. Essentially, this means that as a recruit goes through the line to fill out his Bag, the selected QR item is bar-coded with a hand-held scanner.

A competitive Indefinite Delivery Type Contract (DITCH) contract will be let by DPSC using Best Value acquisition methods. It will be the responsibility of the contractor to restock the RIC or RICs shelves as a particular sized item falls into reorder. All of the information provided above will be utilized by the vendor to accomplish that task in a pre-determined and limited amount of time.

DPSC will have all of the RIC information as well as stockage levels and production rates from the vendor's plant. Stock of the selected QR item for other than the RIC or RICs will still be placed in the depots, and will act as a safety net for the QR project. If DPSC should suspect that the QR system cannot fulfill the RIC's needs, a depot will be notified to release a shipment. This safety net should assuage a Service's concerns over a supply failure.

The RIC or RICs may be involved in either a PULL system or a PUSH system. In the PULL system, the RIC would act very much as it does today —placing orders through requisitions to DPSC. DPSC in turn would place delivery orders against the indefinite delivery/indefinite quantity contract for direct delivery. Billing would then be placed against a valid requisition.

Under a PUSH system, the vendor would determine the RIC's needs based on a model replenishment system and automatically restock the shelves. DPSC and the Service would only overview the system. DPSC would issue delivery orders which correspond to vendor shipments (within established parameters) or have the vendor notify DPSC to confirm the need to make a shipment and place an appropriate delivery order. The RIC would have the right to refuse a shipment should the contractor and/or DPSC mis-compute the need. Once shipment is accepted, billing and payment will be effected.

In reality, a system which is part PUSH and part PULL may be adopted. A more precise picture of the operations will be available after we have met with the industry members and the Service.

Conclusions

QR is a system that, although in its infancy, has shown that it can work to improve the way in which a business operates. It is also a fact that this mode of operation will some day be the norm in industry.

The hardware is currently available, as are a multitude of Third Party Network companies to handle the interactions of the various parties. Further, DPSC now has in place the contractual mechanisms which would allow the successful completion of a contract negotiation. A Source Selection acquisition method would include the evaluation of QR systems and Third Party Network capabilities.

DPSC needs to become involved in QR now. The Government has traditionally lagged behind industry in adopting new ideas and technologies. This is a perfect opportunity to be among the industry leaders in promoting new ways of doing business. Were we to be left behind now, we would spend years just trying to catch up.

Further, at the same time DPSC will be reaping the benefits of QR, it would also demonstrate DoD's efforts to contribute to the US becoming world competitive in today's global economy. DPSC will implement QR on a test basis in the Clothing & Textile Directorate. One item, being delivered to one customer by one commercial vendor, has been chosen for the purpose of demonstration. In the development of QR in the Clothing & Textile Directorate established industry procedures and standards will be utilized wherever possible. DPSC will not create a government peculiar system. Once implemented and fully operational, it will then be expanded in a well planned phase-in to other applicable items.

APPENDIX F

COMMERCIAL/NON-DEVELOPMENTAL ITEMS

APPENDIX F

COMMERCIAL/NON-DEVELOPMENTAL ITEMS

Introduction.

Acquisition streamlining is a subject of many Department of Defense (DoD) studies. It is a common-sense approach to making DoD's acquisition programs more effective and efficient. Its ultimate goal as stated in DoD directive 5000.43 is to reduce the cost and time it takes to field operationally suitable weapons systems and acquire their supporting services.

Among the programs that exist beside the general concept of streamlining I would cite William Perry's report to the president, *A Formula for Action*, designed to encourage effectiveness in the acquisition process. Baselining (DoDD 5000.45), Value Engineering (DoDD 4245.8), Design to Cost (DoDD 4245.3), Data Management (DoDI 5010.12) and Acquisition of commercial products and non-developmental items (DoDD 5000.37) are comparable processes that one must consider. This chapter addresses the latter.

Underlying Features that Typify Commercial Acquisition.

There are six underlying features that typify almost every successful commercial program. They are:

1) Clear responsibility. A commercial program manager (PM) has clear responsibility and a short line to the Chief Executive Officer (CEO), group general manager or a comparable decision maker.

2) Stability. There is a fundamental contract between the CEO and the PM on cost performance and schedule. So long as the PM lines up to this contract the CEO provides strong management support throughout the life of the program.

3) Limited Reporting Requirements. A commercial PM reports only to his CEO. Typically this is on a "management by exception" basis.

4) Small High Quality Staffs. Commercial PM staffs are much smaller than defense. The people are hand selected and extremely high quality.

5) Communication with users. The PM has a close dialogue with the customer(s). This starts day one and goes through completion.

6) Prototyping and Testing. All unproved technology is realized in prototype hardware and tested before design approval or production authorization.

It is clear that defense acquisition typically differs from this commercial model in almost every respect. Yet a few DoD programs have used a few of these management features to a greater or lesser degree. The key then is to create steps when defense (Army) acquisition can emulate this model to the maximum extent practical.

Acquisition Process/Improvements.

Develop a strategy to address. Research, Development, Test, and Engineering (RDT&E), use teaming of life cycle engineering discipline during development, statistically designed experiments, continuous evaluation of testing, prototype proof of production and lab streamlining to reduce time

and funding needs. The procurement of hardware entails a heavy reliance on the skills of qualified, experienced industrial organizations committed to major improvements in quality and efficiency. That will require long term procurement commitments from the Army coupled with reliance on performance oriented specifications and increased use of commercial specifications.

The strategy would need to rely on a commitment to *quality*. It requires continuous improvement to management and industrial processes that can be measured by financial savings. The budget accounts in the Army can then be stabilized. The Army should, in this way, be able to procure more for less.

- There is a need for congressional change. One could write a book on that.

- The Defense Management Review (DMR) recognize that redoubled efforts are needed to obtain improvement in acquisition. This is illustrated by the documented results of the Packard Commission and the Goldwater-Nichols Act. Little has been done to implement the majority of the intent of either. Sustained commitment is viewed as essential to help acquire the needed new systems at less cost, quicker and with better performance. The major problem to overcome is an erosion of the US. Industrial Base. This is indicated by a decreasing return on fixed assets, declining capital investment and falling productivity in the key defense sectors.

The DMR points to a need for:

- program stability
- limited reporting requirements
- better system development
- greater accountability by industry
- industry self government
- better industrial performance

A strategy needs to be evolved. It should be based on the establishment of continuous and urgent improvement of the acquisition processes in the Army. It should apply to RDT&E, procurement as well as depot activity.

The cost reduction strategy related directly to the objectives of the DMR that are document in the Sec Def Report to the President dated July 1989. The objectives contained in the Secretary's report that related to the category of actions envisioned by the Army's strategy are summarized as follows:

- RDT&E Actions. Assure low cost approaches for weapons systems that are effective. Use systems engineering and validation of manufacturing processes as early as possible. Effect early test and evaluation and aggressive use of prototyping and testing. Regarding technology, use the available capabilities to a maximum advantage.

- Procurement Actions. Push industry to greater competitiveness with simultaneous quality improvements and cost reduction illustrated in other sectors of US. industry. Develop more reliance on effective contractor system on controls. Evolve contractor self-governance. Eliminating overhead and reducing payroll costs of contract administration service workforce. Expand use of broad performance specifications in weapons design. More use of commercial product. Increased use of commercial competition. Adopt competitive practices based on "best-value" to the Army. Recognize suppliers for good performance. Eliminate unnecessary reports and reviews on program offices and contractors.

- Depot Operations Actions: Overall improvement in the efficiency of DoD's acquisition management logistics, distribution and related maintenance activities.

Before proceeding further it is worthy at this stage to provide an industry view. The primary source for that was a joint Government/Industry workshop on total quality management (TQM) in contracts sponsored by US. Army Material Command with ADPA, National Security Industrial Association (NSIA), AIA and EIA. The following were recommended as to how to increase industry motivation for continuous improvement in cost reduction.

- Use performance specs not product specs.
- Make awards based on "best value"
- Assure follow-on business. Recognize the role and need for capital investment. Encourage same for quality improvement and cost reduction.
- Provide incentives for capital investment.
- Define in advance performance parameters desirable to improve and include a profit improvement schedule in the contract for each parameter.
- Expand use of multi-year contracting.
- Encourage creation at single suppliers provided cost and quality improvements are met.

There are several RDT&E actions that can be taken to focus on improving the efficiency of product development. This will result in less time and a savings of previous funds. The actions are:

- Mandate concurrent engineering
- Continue use of acquisition strategy for proof of production.

This would require a proof of production demonstration during development. One way to reduce risk is to require hard tooling for hardware manufacturers of hardware used in Development Test II and Operational Test II. (DT/OT II). All operations in the line need to be represented as opposed to a balanced line in a classical industrial engineering sense. Establishment of this proven out line would serve as a basis for identification of critical processes, control parameters, and even a rough range of acceptable values that this became the basis for SPC for the full production line.

Proof of production also includes a first article test and configuration audit during FSD. This updates the TDP, certifies the line and allows refinement and validation of process control.

The total effect is to commit to a mature design prior to the start of full production and to have the proven capability ready when that decision is made.

- Use statistical design of experiments.

Focus on both optimization experiments for both design (product) and manufacturing processes. Examine relationships among the variables.

- Use performance specifications.

- Improve the testing process.
- Mandate CP^2 across the Army by FY 94 or 95. Ensure it reduces oversight, in-plant contract administrative services, inspections, and contract data requirements.
- Streamline TDP acquisition. Avoid the expense of drawings and specs if unnecessary.
- Program stability plays a critical role in minimizing total cost in production. Once established, the Army must stick with a comprehensive acquisition strategy to eliminate wasted effort and restarts.
- Provide investment protection for capital investments for achieving quality improvement and cost reduction.
- Use commercial procurement practices for outside purchases. Need to get to quality issue for suppliers and eliminate all other regulated, compliance-driven DoD needs. See table below.

Further Recommendations:

There are a number of further recommendations to be made to simplify the DoD acquisition regulations. In many cases it would make the process much like a commercial buy.

1. Permanently raise the threshold for requiring the submission of certified cost or pricing data to $500K. (Currently it is $100K with a temporary raise to $500K until December 31, 1995.)
2. Broaden exemption for cost or pricing requirements if:
    - product or service is purchased from a company or division which procures the same product for the commercial market.
    - the price is fair and reasonable.
3. In bid protests, consolidate or confine bid protests to one forum.
4. Change post-award debriefing procedures to allow the automatic stay provision to occur if the protest is filed ten calendar days after contract award or within five calendar days after the date of the debriefing.
5. Waive or modify CAS for most transactions involving commercial entities.
6. Simplify certification requirements and limit certifications to those related to the acquisition.
7. Allow for the protection of Intellectual Property rights of commercial items. Limit the Government's rights to the Contractor's commercial items so the Contractor can maintain their competitive edge.
8. No Qui Tam suits should be allowed by Government employees if the basis of the claim was obtained during the employee's regular duties.

9. Broaden the definition of commercial items to include more than just off-the-shelf items.

10. Limit Government audit rights on commercial products if the price if reasonable. The Government can rely on catalogs or prevailing market prices in determining whether the cost of the commercial product is reasonable.

Government	*Commercial*
Regulated • Congress (law) • DoD (Regs FAR/DAR Etc)	Flexible • Control own policies • Change to meet Reqt's
Rules Dependent on Product • R&D • Production • Comply with laws not related • Spares • Services • Construction	Rules • Best Comm Practices • Comply with Laws directly related OSHA, EEO, Anti-trust, etc. • Prudent, Ethical, Efficient
Full Competition • Max extent possible • Most procurements	Compete When It Makes Sense
Procurement Sensitivities • Focused on Prime • Socio-economic goals • Price vs. quality • Protectionism • Annual budgets • Fraud & defective pricing	Procurement Sensitivities • Customer value • Highest quality • Lowest cost • Market leadership • Market share • ROA
Annual Contracts Buy to Government Specs and Stds Pricing • CAS Micromanagement Annual Funding	Long Term Agreements/Relationships Buy to Flexible Specs and Stds Pricing • Std accounting techniques Complete Vendor Involvement Full Program Funding

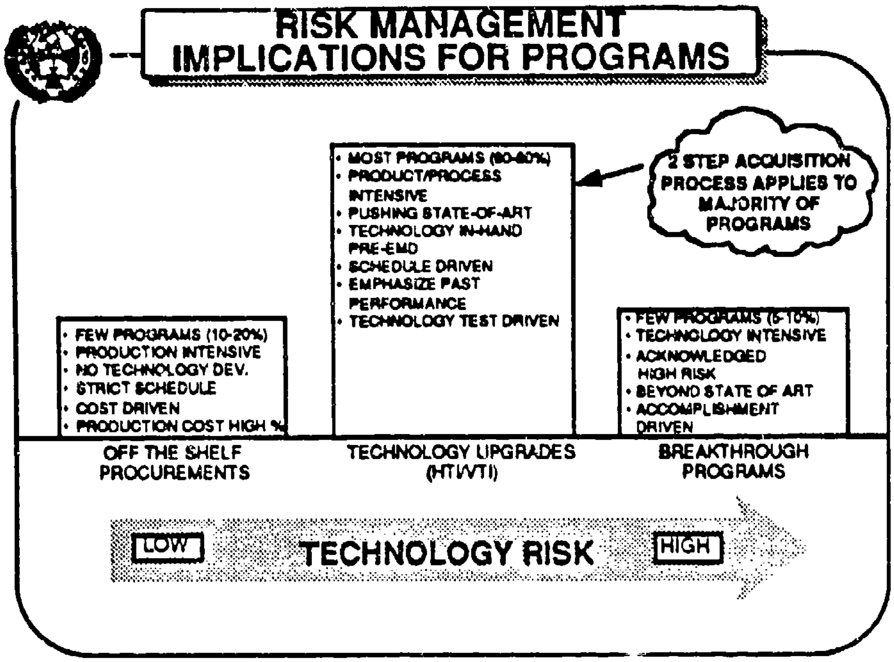
Procurement Practices-Government/Commercial

APPENDIX G

RISK MANAGEMENT

APPENDIX G

RISK MANAGEMENT IMPLICATIONS FOR PROGRAMS



The application of these types of lists to any particular program would follow this thought process:

1. Do I have such a risk?
2. If yes, is it high risk?
3. If high risk, do I have a backup approach? When must I prove it to have a chance of recovery?
4. If low risk, nevertheless, I must schedule proof of performance before research and development (R&D) is over. When does it best fit within the normal sequence of development?

This would be done for every Red Flag item even if the designer insists there is no risk (if such is the case, he'll have no trouble meeting the specs and schedule).

Cynics can now speculate if PMs will obfuscate or hide big issues. However, if we insist on a review of an original one page risk matrix and an answer to the questions, "Does this thing meet its operational objectives? Does it work?", the probability of avoiding an FSD with unproved technology are significantly enhanced.

Some probable questions about this approach:

- Does this mean we will build more prototypes than in the past? Probably.
- Does this mean we may need to use two or three technology alternatives to ensure risk reduction? Yes, sometimes.

- Are you telling me that software operating systems must exist and be proven under load by the end of R&D? Yes.

- Will you accept simulation of traffic flows (both intra and trans system) as demonstration of proof? No, we need actual hardware and software demonstrations. We expect the use of simulation early in the program as a means of risk reduction and as a design tool.

- Will you accept Battle Lab simulation as proof of operational performance to FSD? No, the Battle Labs are a necessity to establish operational need and provide a test bed for a program to interface. If there is technology Risk associated with battlefield integration, you will prove it with actual prototypes.

There will be a thousand healthy questions spawned, the important thing is they will occur during R&D and not during EMD.

We recommend that we trust the Government Industry team to provide us a risk minimized system. The control on that trust is the single USDA review between phase one and phase two.

Last, we must recognize high turnover of personnel, and loss of "corporate" memory in both the Army and Industry. Some of this "last" knowledge can be impacted by training. We recommend a DSMC course in risk reduction specifically featuring the development of the red flag list, the summary risk matrix, and the use of DIS and the Battle Labs ... for combined Army/Industry attendees. We would propose that an expanded version of the Integrated Development Team be established to conduct the rebaselining. This IDT would evaluate six distinct areas: Requirements and Systems Architecture, Data Definitions, Common Applications Software Systems (CASS), Common Hardware and Operating Environment Software (CHSII+) and the Communications infrastructure to support ACCS.

We would propose that each program office in the ACCS family be taxed for three or four individuals -- to support the six IDT teams. The proposed breakout might be:

- The TSM other user reps, the system architects would form a business re-engineering team for each major sub-system, MCS, ASAS ... after two months all the components of the ATCCS elements would form the ATCCS re-engineering room to harmonize the sub-system into the overall ATCCS, and finally all elements of the ATCCS would form the ACCS group "until they got it right." This business re-engineering process would result in a new class of requirement documents -- flow chart like structures which describe the data flow and define the processing required, and data base definitions which completely define the data to be provided to each node in the system.

- Individuals from each vendor, PM, TSM office who work data would form the data standardization team who would be responsible for bringing the ACCS dictionaries into conformance with the DISA JTEO direction.

- All proponents of a Common Applications Software System from the CASS team. They would be provided a "laboratory" with work stations which could support software evaluation. This group would not see the light of day until a "common CASS" was agreed upon.

- System engineers from each component would form the CHS II+ team and would evaluate the candidate systems, including running their existing applications code before a source is selected.

- All communications engineers, signal personnel, data parsers, etc. would form communications architecture team. They would be tasked to tie the multiple communications elements and their supported automation into a smart data exchange system. In addition, the team should do an end to end review of the voice connectivity on the battlefield.

- These last three teams, CASS, CHS II+ and communications would move into the lab environment for months six through nine to establish the ACCS Development Environment (TADE). All the elements defined by these teams would be integrated and documented to the satisfaction of the group.

The final steps in this process would be:

- Existing applications code would be brought into the lab and ported into TADE to demonstrate to both the operating environment team and the applications software group that a common environment be achieved, which is capable of supporting all applications.

    - The requirements and business re-engineering team would meet with the applications software team to:

        - Evaluate the utility of existing applications code.

        - Identify the code which would not be pursued.

        - Agree on the requirement to be met with existing code and the priority of development of new software to fill identified gaps.

        - Finally the data element group would present their data set to the business re-engineering group and the applications software group for suitability and completeness.

At the end of the year the community would be in a position to redefine all elements of ACCS, based on the requirements defined by the process, with the added advantage that both the government users and developers will share a common perception of the problem with the vendors. This approach would move the ACCS from the realm of 30-40 different contract/vectors to a common basis of design and implementation. By virtue of it "cleaner environment" and commonalty of hardware and software is likely to be much more affordable.

It can be argued that this rebasing team is overkill, too late, and/or unnecessary, but the history of Army automation clearly argues for this through review with sufficient rigor to avoid a continuation of a process which shows little sign of converging to the desired "Seamless Command and Control."

And last, it is appropriate to take higher risks on some programs which promise break-through capabilities and have a high urgency. These should be few in number.

As technology upgrades (HTI and TI) are expected to comprise the bulk of Army programs, we recommend a technology risk reduction based, two step acquisition methodology as shown in Figure 3.0.

The change called for here is a simple but major shift in managerial paradigm. It recommends the Army should focus on a two step acquisition methodology which can operate under existing DoD methodology and be accomplished within the Army's own prerogatives.

The entire focus is proving, via demonstrations, that the employed technology will perform to the necessary levels by the time R&D (the first step) is finished. The Government Industry Team does this with the full knowledge that:

1. At the end of phase one, the technology performance parameters must be met of the program will be terminated.

2. Moving to step 2 (actually integrated engineering and manufacturing development) with any technology risk still existing is unacceptable.

In this process, the technology risk is retired prior to production. To assure this is accomplished at program outset, all technology risk factors must be identified, and proof (demonstrations) of their risk reduction to satisfactory levels must be planned. To promote schedule and cost realism, contracts should be structured such that id these proof points are not satisfied, the contract automatically terminates. (The only exception would be a continuance decision by the Army Acquisition Executive.)

Tools to Manage Risk.

The following management tool development is recommended.

1. An Army/Industry PM team should develop a one page risk identification format which will be filled out within three months of program start. This risk format will be used by the PM to track his status against performance specs until the end of phase one, when it is available for USDA review.

2. A risk sieve or Red Flag list. Experience has shown many technology risk areas are common across many programs. This Red Flag list will help the PM attack most (but there is no promise of all) technological risk areas.

It is important that a team of Army/Industry PMs develop this list in order to capture the experience which exists. The four area groupings and examples are a product of our experience and intended for illustrative purposes, and as a basis for an action item:

Group I	Electronic Risk
Group II	Software Risk
Group III	Electromechanical Risk
Group IV	Materials Risk

As an example, electronics risk might include:

1. Any new or modified high power RF tube or transistor.
2. Any new process LSI chip.
3. Any LSI chip with less that 2 micron feature size.
4. Any frequency synthesizer.
5. Any power supply employing chopper technology.
6. Any focal plane array.
7. Any CD or IR sensor.

Software risks might include:

1. Real-Time system.
2. Real-Time distributed system.
3. Real-Time Imbedded Microprocessor System
4. Unique data bases
5. Distributed data bases
6. Relational data bases in Real-Time systems
7. Dynamic resource allocation/on-line load leveling
8. High number of source lines of code:
   Greater than 1,000,000
   More than twice as many as in prior experience
9. New hardware architecture of new software language
10. Unfamiliar security requirement
11. High PMFL requirements
12. Lack of available alternative approaches
13. Inappropriate requirements too restrictive for required functionality
14. Portability of heritage code

The primary features of the two step acquisition strategy are:

- The five phases of the current strategy are consolidated to two phases
- Technology risk reduction is accomplished by the end of the first phase. If it is not retired, the program shall not proceed.
- A major risk review point occurs (end of step 1) before major engineering and manufacturing moneys are expended. This is accomplished using the risk matrix developed by the program manager during the first three months of the program.

Mission needs and R&D are interactive, employing digitization, DIS, Battle Lab concepts, simulation, and demonstration.

Risk Reduction

The most fundamental risk that Army officials must manage is the risk that a system does not perform adequately in battle., If a device or machine does not work for its intended purpose, then the program is a failure. All the smart contract clauses and detailed testing are of no avail if we fail to ask the single all encompassing question, "Does this thing do its job?"

The recommended two-step acquisition strategy focuses on this jugular issue. It is appropriate, then, to address some details of risk reduction, and make further recommendations for their implementation as stated on Chart 4.0.

APPENDIX H

GLOSSARY

APPENDIX H

GLOSSARY

AAE	Army Acquisition Executive
ACCS	Army Command and Control System
ADA	Air Defense Artillery
AFATDS	Advanced Field Artillery Tactical Data System
APA	Aircraft Procurement Army
ARL	Army Research Laboratory
ARTY	Artillery
ASAS	All Source Analysis System
ASB	Army Science Board
ATCCS	Army Tactical Command and Control System
AVN	Aviation
ABCC	Airborne Command and Control
AH-64	Advanced Attack Helicopter
Avenger	Air Defense Missile System
BFA	Battlefield Functional Area
BOC	Battlefield Operational Capability
C2	Command and Control
C2V	Command and Control Vehicle
C3I	Command, Control and Communications Integration
CASS	Common Operations Software Systems
CCD	Charge Coupled Device
CD ROM	Compact Disk Read Only Memory
CGS	Common Ground Station
CHSII+	Common Hardware and Operating Environment Software
CINC	Commander-in-Chief
Comanche	Next Generation Armed Reconnaissance Helicopter
CONUS	Continental United States
CSA	Chief of Staff Army
CSS	Combat Service Support
DIS	Distributed Interactive Simulation
DISA	Defense Information Systems Agency
DoD	Department of Defense
DSB	Defense Science Board
DSMC	Defense Systems Management College
DTED	Digital Terrain Elevation Data
EMD	Engineering and Manufacturing Development

ENGR	Engineer
EPLRS	Enhanced Position Locating and Reporting System
FAADC2	Forward Area Air Defense Command and Control
FIST	Fire Support Team
FLIR	Forward Looking Infrared
GBCS	Ground-Based Common Sensor
HTI	Horizontal Technology Integration
IDM	Improved Data Modem
IDT	Integrated Development Team
INF	Infantry
IR	Infrared
IVIS	Intervehicular Information System
Javelin	Man-portable, Antitank Missile System
JCS	Joint Chiefs of Staff
JIEO	Joint Interoperability Engineering Office
JSTARS	Joint Surveillance Target Attack Radar System
JTF	Joint Task Force
LOS	Line of Sight
LSI	Large Scale Integration
M1	Main Battle Tank
M2/M3	Bradley Fighting Vehicle
MCS	Maneuver Control System
MLRS	Multiple Launch Rocket System
MLS	Multilevel Security
MPA	Missile Procurement Army
NBC	Nuclear, Biological, and Chemical
OH-58	Armed Scout Helicopter
PALLADIN	Self Propelled Howitzer
PM	Program Manager
PMFL	Performance Monitoring and Fault Location
R&D	Research and Development
RAH-66	Next Generation Armed Reconnaissance Helicopter
RDA	Research, Development and Acquisition
RDEC	Research, Development and Engineering Center

S&T	Science and Technology
STRICOM	Simulation, Training, and Instrumentation Command
TADE	The ACCS Development Environment
TENCAP	Tactical Exploitation of National Capabilities
TOA	Table of Obligation Authority; Table of Allowance
TOR	Terms of Reference
TRADOC	Training and Doctrine Command
TSM	TRADOC System Manager
TU	Technology Upgrade
UAV	Unmanned Aerial Vehicle
USD(A)	Under Secretary of Defense (Acquisition)
VTI	Vertical Technology Insertion
WCTV	Weapons Combat Tracked Vehicles

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